Wolf
Management Report
of survey-inventory activities
Federal Aid in Wildlife Restoration
1 July 1996–30 June 1999

Mary V. Hicks, Editor
Alaska Department of Fish and Game
Division of Wildlife Conservation
December 2000

Please note that population and harvest data in this report are estimates and may be refined at a later date.

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STATE OF ALASKA

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LOCATION

GAME MANAGEMENT UNIT: 14 (6624 mi^2)

GEOGRAPHIC DESCRIPTION: Eastern Upper Cook Inlet

BACKGROUND

Wolf numbers in Unit 14 were probably low to moderate in the 1950s and early 1960s, primarily due to predator control efforts by the federal government (Rausch 1967). Wolf populations probably increased during the late 1960s and early 1970s, after cessation of predator control activities and bounty payments. Development in the Anchorage and Matanuska–Susitna Valley areas was probably responsible for wolf numbers remaining low near human settlements during the 1970s. Subsequent large increases in human population in this area caused substantial increases in hunting and trapping pressure, and by the mid to late 1980s, wolf numbers were relatively low throughout Unit 14. During the early 1990s wolf populations increased, in part because of high prey densities and excessive winter moose mortality caused by deep snows during the winters of 1989/90 and 1994/95. High wolf densities also occurred in adjacent areas having reduced hunting and trapping pressure. Wolf numbers remained high through 1999; hunters, pilots and winter recreationists frequently observed wolves. The reported harvest has increased significantly, coincident with high wolf densities.

During November and December 1998 trappers caught several wolves (and coyotes) in Unit 14B that were infested with the dog-biting louse *Trichodectes canis*. This was the first time lice had been confirmed in Alaskan wolves outside the Kenai Peninsula, where louse-infested wolves were first seen in 1981. The source of the Unit 14 infestation was unknown, but we suspect feral dogs or wolf-hybrids. During January 1999 we mounted a large effort to treat infested wolves in the Susitna Valley, with non-lethal means, to prevent the spread of lice to other areas of the state. Our efforts revealed that 2 packs in Unit 14B were infested and 1 pack in adjacent Unit 16A. We attempted to capture and treat all infested wolves with the antiparasitic drug ivermectin (Merial, Iselin New Jersey USA). We also distributed approximately 1200 medicated baits, aimed at coyotes, dogs, and lone wolves. However, several louse-infested wolves were caught during winter 1999–2000, indicating we were unsuccessful in eliminating lice from area wolves.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

In Units 14A and 14B the primary goal is to provide for optimum harvest of wolves. In Unit 14C the primary goal is to provide opportunity to view, photograph and enjoy wolves. The secondary goal for all of Unit 14 is to provide maximum opportunity to participate in hunting and trapping wolves.

MANAGEMENT OBJECTIVES

The population objective is to maintain a minimum unit population of 55 wolves, with 35 wolves in Subunits 14A and 14B (combined), and 20 wolves in Subunit 14C. The human-use objective

in Units 14A and 14B is to allow low levels of human harvest by hunting and trapping, provided harvest does not conflict with maintaining the population objective. The human-use objective in Unit 14C is to provide for nonconsumptive uses such as viewing, photography, listening, and the knowledge that wolves are present.

METHODS

Most reports of wolf distribution and pack size came from incidental observations by staff and the public, from sealing certificates, and interviews with wolf hunters and trappers. We collected harvest data when wolf hides were presented for sealing. All trappers who sealed fur in Unit 14 were queried, through our trapper questionnaire, regarding trends in wolf abundance.

With the unanticipated discovery of louse-infested wolves in this area, and the fear the infestation would move north, we met with staff from headquarters and regions 2 and 3 to discuss management options, political considerations and funding strategies. With direction from the Governor's office, we decided that area staff would use non-lethal means to attempt to eliminate lice from Susitna Valley wolves and coyotes, employing a capture/treatment program for wolves and distribution of medicated baits for coyotes. Additionally, regional staff would attempt to treat domestic dogs in the Parks Highway corridor.

We enlisted the aid of several other area biologists in our effort to capture and treat all infested wolves in the Susitna Valley. We used aerial reconnaissance from Piper PA-18 aircraft to first locate and examine wolf packs and then we captured 1–2 wolves in each pack to confirm the presence or absence of lice. We then captured and treated all known members of the infested packs, using 2 capture crews with 2 Robinson R-22 helicopters. Wolves were immobilized using Telezol (tiletamine HCL and zolazepam HCL, Fort Dodge Lab, Fort Dodge, Iowa, USA), and ivermectin was administered to rid wolves of lice. We also distributed meat baits, containing ivermectin paste, in the general area occupied by infested packs, to attempt to medicate coyotes and lone wolves potentially missed during our capture operation. Radiocollared wolves were tracked periodically to visually assess pelt characteristics and whether all pack members had been treated. No efforts were made to treat domestic pets in the affected area. The louse control effort is outlined completely in Golden and others. (1999, Appendix A).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

With information gathered during the lice control project, coupled with sealing information and observations from trappers and the public, we estimated Unit 14 contained 120–160 wolves during fall 1998 (Table 1). While this appears to be a large increase within a 5-year period, we believe wolf numbers have not changed significantly in recent years, and wolf numbers were under-estimated in earlier years. The effort to control the spread of lice allowed us to get reliable minimum estimates of pack sizes and distribution in most of Unit 14B and the western portion of Unit 14A, the resulting numbers were substantially higher than previous estimates in those areas. This demonstrates that the "traditional" method of estimating wolf populations solely from

incidental observations by staff, trappers, pilots and other outdoor enthusiasts probably results in a significant underestimation of wolf numbers. Further, we may be able to detect only large population shifts through traditional methodology.

Distribution and Movements

Areas in Unit 14 that contained wolf packs included Upper Talkeetna River, Wells Mountain, Lower Talkeetna River/Sheep Creek, Iron Creek, Montana Creek, Kashwitna River/Little Willow Creek, Willow Mountain, Bald Mountain, Lower Little Susitna River, Goose Bay, Kings River/Moose Creek, Chickaloon River, Carpenter/Wolverine Creeks, Knik River, Lake George, Eklutna River, Elmendorf/Ft. Richardson, Ship Creek/Eagle River, and Portage/Twentymile Rivers. The effort to control lice reaffirmed that, in contrast with our efforts to estimate population size, our method of seeking pack distribution information from trappers, pilots and staff provides relatively good information about the general location of pack territories.

Diseases/Parasites

Of 6 packs examined during louse-control effort in Units 14A and 14B, 2 packs (Willow Mountain and Montana Creek) were confirmed to have lice. Of 2 other packs in eastern Unit 14A evaluated by inspecting the hides of wolves taken by trappers or hunters, neither appeared infested (Golden and others. 1999, Appendix A). We captured and treated 12 wolves in the Willow Mountain pack, 4 wolves in the Montana Creek pack, 2 wolves each in the Bald Mountain Ridge and Sheep River packs, and 1 wolf in the Kashwitna River pack. The operational cost of the louse-control effort was $60,000 (including both Units 14 and 16). There were no indications that any 14A or 14C packs were affected. Because coyote and domestic/feral dogs are known to harbor lice, it is very difficult to totally remove lice from the area.

MORTALITY

Harvest

Season and Bag Limit. During the report period the hunting season for Unit 14 was 10 August–30 April, with a bag limit of 5 wolves. The trapping season in Units 14A and 14B was 10 November–31 March, and in Unit 14C the trapping season ran 10 November–28 February. Trappers had no bag limit on wolves.

Board of Game Actions and Emergency Orders. During June 1993 the Board of Game authorized same-day-airborne shooting of wolves, provided the person attempting to take the wolf had a trapping license and was at least 300 feet from the airplane. During November 1996 this method of take was prohibited through a statewide ballot initiative, but the prohibition did not go into effect until February 25, 1997.

During January 1998 Division staff asked the Board of Game to clarify whether wolf-hybrids could be possessed without a permit. The Board addressed the subject by stating that in their view possession of any hybrid of an animal not on the "clean" list had always been illegal, but they added language to 5AAC 92.029 explicitly addressing possession of hybrids. Top officials in both the Division of Wildlife Conservation and Department of Public Safety, Division of Fish

and Wildlife Protection (DPS/FWP) stated, however, that they would take no drastic enforcement action against the many people, and several businesses, who possess and sell hybrid wolves.

Hunter/Trapper Harvest. Harvest averaged slightly over 21 wolves per season during the 5 seasons spanning 1994/95–1998/99 (Table 2), continuing an increasing trend since 1992–93. Unitwide harvest averaged 2 wolves during the 4 seasons from 1988/89–1991/92 (Masteller 1994). Most of the harvest comes from Unit 14A because it has large areas open to hunting and trapping that are highly accessible to many people.

In recent years most wolves were trapped (Table 2), but the number has fluctuated significantly. The number of wolves shot has remained comparatively stable in the last 4 years. The number trapped can be greatly affected by weather and trapping conditions, whereas the number shot is more dependent on travel conditions.

Harvest Chronology. Most wolves were taken during mid-winter (December–February), although there has been a notable increase in the number of wolves taken during August–October (Table 3). The latter is primarily harvest by hunters afield during moose and sheep seasons. Many of these hunters report seeing wolves with increasing frequency. During 1998/99 there was little snow on the ground during December, and extremely cold temperatures during January. These factors probably combined to increase wolf harvest during February, relative to other years.

Transport Methods. Most successful wolf trappers and hunters used snowmachines to access their trapping/hunting areas (Table 4). Use of aircraft increased in 1998/99, due mainly to several experienced pilot/trappers who, after laying off trapping for several years, made a concerted effort to snare wolves in relatively remote parts of Unit 14. Snowmachine use was curtailed dramatically during 1995/96 because of unusually low snowfall.

Other Mortality

Following the louse-control capture effort there was an extended period of cold weather, with temperatures to 30 degrees below zero Fahrenheit. During this period 2 heavily louse-infested pups (or yearlings) disappeared from the Montana Creek pack. We suspect these 2 wolves died during this cold period, because of heavy pelt damage from lice (Golden et al. 1999, Appendix A). About 1 wolf per year is killed by vehicle collision in Unit 14C.

HABITAT

Assessment

Although wolf habitat in Unit 14 has changed significantly in the last 80 years, the large number of moose has undoubtedly allowed for increases in wolf numbers in the last 30 years. Beaver and hare numbers are currently high as well, providing good summer prey. Salmon escapement has remained fairly consistent at near objective levels, providing an additional summer food source. Wolves are very adaptable and able to use areas altered by humans.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

We received many reports from the public about wolves attacking dogs and possibly threatening other pets and livestock. Wolves have killed an estimated 3–10 dogs/year in the Anchorage area.

As wolf numbers increase, wolf/domestic animal conflicts may increase, especially with the dispersed pattern of human development in this area. Increasingly, we receive similar calls regarding wolf hybrids.

CONCLUSIONS AND RECOMMENDATIONS

While the population objectives have been met for Unit 14, and the number of wolves is increasing, systematic surveys will be necessary to maintain accurate population estimates of wolf numbers. The human-use objective was also met, with both consumptive and nonconsumptive users enjoying many opportunities to interact with wolves, even on the outskirts of urban areas. No changes in seasons or bag limits are recommended.

Surveys should be conducted every 3 years to assess wolf numbers. Minimum pack sizes can best be determined by simple reconnaissance flights when tracking conditions are best, utilizing 2–3 aircraft during a short period in January or February. This will require an additional $6,000, and some technical staff time, every 3 years. Current methodology (observations by staff, trappers and the public) should suffice for distribution information.

The spread of the non-native louse to the Susitna Valley is a very serious concern for managers. Unfortunately, the sensitivity surrounding wolf issues prevented managers from acting quickly to attempt to control the infestation. When lice were first discovered (November 1998) in the area, it took almost 2 months for Division staff to decide what course of action, if any, to take. Political considerations precluded action involving lethal methods of control, as was the case during the initial infestation on the Kenai Peninsula (Golden et. al 1999). By the time most wolves were treated (late January 1999), some wolves had probably begun to disperse (Mech et al. 1998). Although a great effort was expended to attempt to treat infested wolves during early 1999, financial and feasibility considerations precluded a follow-up program during winter 1999/2000 to assess the effectiveness of the effort. In addition Regional staff were unable to act on recommendations to treat domestic dogs in the Parks Highway corridor because of a number of Food and Drug Administration regulatory barriers.

Several infested wolves trapped during 1999/2000 (mainly in Unit 16) indicate we were unsuccessful in eliminating lice from Units 14 and 16. With current high wolf densities this parasite could spread rapidly within the Susitna Valley. Given natural dispersal rates for wolves, it appears likely that lice will infest wolves in other parts of the state in the near future. This could reduce wolf harvest rates, impacting prey populations, trappers and managers involved in intensive management programs. It could also affect wolf-viewing programs in areas like Denali National Park.

As suggested by Golden and others (1999), the division should develop a specific policy regarding louse infestations among wild canids in Alaska. Hopefully, such a policy would address appropriate actions and political and financial considerations, well ahead of the "crisis," allowing managers to act quickly in the event of infestation. At one time our objective was to confine the infestation to the Kenai Peninsula, but we have failed. Managers in other areas should be prepared to answer public inquiries regarding division policy regarding louse infestation among wild canids in Alaska.

The potential for wolf-human interactions, both positive and negative, in Unit 14 make this an excellent place to study wolves (e.g., population dynamics, prey selection, movements, dispersal, and "adaptability") in habitats that have been substantially altered by humans. Basic research on distribution and abundance could also further our educational, viewing and listening opportunities. Many aspects of wolf-lice relationships, such as pup survival in wolves and effects of cold temperatures on lice, could be studied in the Susitna Valley.

Estimates of harvest rates, based on the estimated number of wolves (Table 1), have remained at approximately 20% during the last 3 years. This is well below the 40% harvest rate considered sustainable in other areas (Ballard et al. 1987), and allows for further increases in wolf numbers (assuming the prey base is adequate). This will certainly affect area moose, sheep and caribou populations. Continued high wolf densities will also promote dispersal of young animals from established packs, potentially accelerating the spread of lice.

There is a compelling need for a clear policy on possession of wolf hybrids, since both ADFG and DPS/FWP have chosen not to enforce the regulation prohibiting possession of these animals. Enforcement is admittedly difficult because people can circumvent the regulation by claiming their animal is a "husky-mix," and to date there are no genetic tests that can differentiate between pure and hybrid wolves. Also, the Matanuska-Susitna Borough, which requires registration of all dogs, will not register an animal as a wolf hybrid because there is no approved rabies vaccine for hybrids. Many people own hybrid wolves in this area, and we receive many complaints about hybrid wolves running loose and threatening humans and livestock. This has resulted in a difficult position for division staff, as municipal animal control officials have, in some cases, decided that any wolf-hybrid case is the jurisdiction of the state. Our credibility suffers substantially when we are forced to tell members of other agencies and the public that possession of a hybrid is against state regulation, yet we will not take action to enforce the regulation.

There is a very real danger that wolf hybrids, through their potential association with both dogs and wolves, may introduce new diseases into wild wolf populations. This is especially true when wolf densities are high and wolves seek prey items near human habitation, and when many dog and wolf-hybrid owners shun veterinary care and seek remote living conditions. When the Board of Game clarified that possession of hybrids was not legal, DPS/FWP sent letters to the 2 major breeders/sellers in this area, asking them to cease selling hybrids. Neither vendor replied to the letter, and no further action was taken (Sgt. Charles Yoder, personal communication). I speculate that the potential for prosecution, coupled with obvious financial difficulties, may have led some wolf-hybrid owners to release their hybrids into the wild. This in turn, may have introduced lice into the wild wolf population, as all louse-infested wolf packs bordered that part of the Parks Highway.

I believe the division should develop a policy to permit current hybrid owners to keep their animals, as long as owners can prove the animals have been spayed or neutered, and aggressively enforce the regulation prohibiting future ownership. Concurrently, our research section should investigate whether new genetic techniques will help distinguish between hybrid and wild wolves. Alternatively, we could possibly develop a morphological key that could identify most hybrids that are closely related to wolves, or empanel a group of breeders, animal control officers, veterinarians, and biologists to make classifications based strictly on phenotypic

characteristics. (Most professionals agree they can tell when an animal has a large percentage of wolf.) Both alternatives could theoretically achieve the goal of identifying animals that look like wolves.

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Table 1 Unit 14 fall (pre-trapping season) wolf population estimates, 1994–1998

Year	Population estimate	Packs (nr)	Basis of estimate
1994/95	60-85	8-11	Sample Unit Probability Estimate in 14C, incidental observations in 14A and 14B.
1995/96	70-100	9-11	Incidental observations, sealing records, reports from public
1996/97	80-115	11-13	same as above
1997/98	70-105	11-13	same as above
1998/99	120-150	19-21	ADFG staff; wolf/lice project

Table 2 Unit 14 wolf harvest, 1994–1998

Regulatory year	Reported harvest				Method of take			Successful Trapper/hunters
	M	F	Unk	Total	Trap/Snare	Shot	Unk	
Unit 14A								
1994/95	9	7	0	16	9	7	0	8
1995/96	12	7	0	19	14	5	0	6
1996/97	6	4	0	10	8	2	0	7
1997/98	4	2	0	6	3	3	0	6
1998/99	6	7	1	14	10	4	0	10
Unit 14B								
1994/95	2	2	0	4	1	3	0	2
1995/96	2	0	0	2	2	0	0	1
1996/97	2	2	0	4	2	2	0	3
1997/98	3	2	0	5	2	3	0	4
1998/99	5	5	0	10	9	1	0	6
Unit 14C								
1994/95	0	2	0	2	1	1	0	2
1995/96	0	3	0	3	2	1	0	3
1996/97	2	2	0	4	1	2	1	3
1997/98	3	0	0	3	3	0	0	2
1998/99	2	2	0	4	4	0	0	2
Unit 14 Total								
1994/95	11	11	0	22	11	11	0	12
1995/96	14	10	0	24	18	6	0	11
1996/97	10	8	0	18	11	6	1	13
1997/98	10	4	0	14	8	6	0	12
1998/99	13	14	1	28	23	5	0	18

Table 3 Unit 14 wolf harvest chronology percent, 1994–1998

Regulatory year	Harvest periods							
	Aug–Oct	November	December	January	February	March	April	*n*
1994/95	14	0	41	41	4	0	0	22
1995/96	4	4	42	33	8	4	4	24
1996/97	0	17	22	22	22	22	11	18
1997/98	28	0	43	7	14	0	7	14
1998/99	11	14	0	18	46	11	0	28

Table 4 Unit 14 wolf harvest percent by transport method, 1994–1998

Regulatory year	Harvest								
	Airplane	Dogsled Skis Snowshoes	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1994/95	9	0	0	23	59	0	0	9	22
1995/96	4	0	0	58	4	0	17	17	24
1996/97	5	0	0	17	50	0	0	28	18
1997/98	7	7	7	14	36	0	28	0	14
1998/99	18	4	0	14	46	0	14	4	28

APPENDIX A

BRIEFING PAPER
ON
INFESTATION OF LICE AMONG WILD CANIDS IN ALASKA

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ABSTRACT

Several biological and social concerns regarding louse infestations in wild Alaskan canids were identified following the recently discovered infestation of lice on wolves (*Canis lupus*) and coyotes (*C. latrans*) in the Mat–Su Valley. The biting dog louse (*Trichodectes canis*) was first identified on a coyote and then on several wolves harvested on the Kenai Peninsula during the winters of 1981–82 and 1982–83. The department attempted to eliminate the louse infestation among the wild canids by capturing and treating them with injections of the antiparasitic drug ivermectin and with ivermectin-treated baits. This effort was not successful in stopping the spread of the infestation, because of the difficulty in catching and treating all infested animals, and funding was stopped precluding treatment after the second winter. In November and December 1998 trappers reported catching wolves and coyotes with evidence of lice in the Mat–Su Valley. Similar efforts to those on the Kenai resulted in all known infested wolves being treated. The results of trying to eliminate lice in coyotes with treated baits were not known. The operational cost of the effort in the Mat–Su Valley was $60,000. The rapid spread of lice among wolves on the Kenai and the recent outbreak in the Mat–Su Valley raises serious concerns that a similar infestation can happen elsewhere in the state. The source of lice in both areas was believed to be domestic dogs, which are infested with lice in a low-level enzootic stage throughout Alaska. The spread of lice to Interior coyotes and wolves, in particular, could have significant effects on the trapping economy and on the quality of wolf viewing. The relationships between parasites and their hosts can be complex, involving lengthy adaptations to each other. With the spread of lice, we may see higher morbidity of wolves and coyotes, particularly among young animals. However, there is no evidence of direct mortality from lice or of a negative population effect from lice on wolves or coyotes in Alaska or the lower 48 states.

INTRODUCTION

The purpose of this briefing paper is to provide the Wildlife Conservation Division Management Team with an overview of our current knowledge of louse infestations among wolves (*Canis lupus*) and coyotes (*C. latrans*) in Alaska to aid the team in policy development. A specific

policy regarding louse infestations among wild Alaskan canids should be considered in light of the recently discovered infestation of lice on wolves and coyotes in the Mat–Su Valley. The policy should address appropriate actions and funds necessary for research and management to implement policy.

The Wolf Conservation and Management Policy for Alaska (revised by the BOG, 29 June 1993) addresses the issue of disease and parasite control as follows:

> Like all other species, wolves have evolved in the presence of many natural diseases and parasites. In most cases, wolf populations are capable of responding to the effects of diseases and parasites without the need for human intervention. However, there may be times when action is warranted to halt the spread of a disease or parasite infestation for the benefit of the overall wolf population, particularly if the disease or parasite is introduced to wolves from an unnatural source.
>
> AS 16.05.020 directs and authorizes the Commissioner to protect the wildlife resources of the state. If, in the Commissioner's judgment, it is necessary to take an action to protect wolves or other wildlife from the adverse effects of disease or parasites, such action may be taken without further authorization by the board.
>
> The only situation in Alaska at this time that meets these criteria for human intervention is the infestation of wolves on the Kenai Peninsula by the biting dog louse *(Trichodectes canis)*. This louse probably infested wolves through initial contact with domestic dogs.

In this paper, we address the following topics:

1. Background on wild canids and lice, specifically the history of their infestation across North America, on the Kenai Peninsula, and in the Mat–Su Valley
2. Limitations to current knowledge on barriers and potential rates of transmission and on the adaptive ability of wild canids to minimize the effects of lice
3. Efforts to control the spread of lice in wolves and coyotes on the Kenai Peninsula and in the Mat–Su Valley
4. Projected effects of lice on wild canids and their management across Alaska if no further control effort is implemented

BACKGROUND

Lice and Their Effects on Wild Canids

Lice are distributed worldwide but are very host-specific (Turner 1971). The biting dog louse (Order Mallophaga) is an ectoparasite believed to live only on dogs, wolves, and coyotes. These lice spend their entire life cycle within 1–2 mm of the skin surface of the host. Eggs (or nits) are cemented to hair shafts and hatch in 1–3 weeks. Their life cycle takes 3–4 weeks and may result in 11–14 generations per year (Turner 1971). Nymphs are smaller but similar to adults, which

grow to 1–3 mm in length. Lice feed on skin debris, particles of hair, sebaceous secretions from the skin, and blood on the surface of the skin. Biting lice irritate the skin of their hosts by their movement and chewing. They are generally not a problem in healthy animals, and heavy infestations are probably due to poor condition of the host rather than the cause of it (Turner 1971).

The most obvious effect of lice on wolves and coyotes has been to their pelts. Pelts of wolves and coyotes infested heavily with lice are often in extremely poor condition, exhibiting various degrees of damage. In moderate cases guard hairs are broken at 10–20 mm lengths and underfur is matted by sebum that exudes from the skin because of the irritation by lice. This creates a smell described as a mix between rotting flesh and earwax. The irritation causes frequent scratching and rubbing. Hair damage and loss is greatest on the back between the shoulder blades and in the groin area. In extreme cases, pelt damage covers much of the body trunk and exposes the skin surface to the elements, causing skin to turn gray. Pups are usually affected most. The condition of louse-infested pelts makes many of them almost worthless to trappers and furbuyers, particularly later in winter when infestations intensify.

Wild Canids and Lice in North America

The occurrence and geographic distribution of louse-infested wolves and coyotes in North America is not well documented. Wolves and coyotes from several counties in Minnesota and Wisconsin were reported to have lice in the early 1980s (Mech et al. 1985), and lice are still common among wolves in Minnesota (William Berg, Minnesota DNR furbearer biologist, pers. commun.). Two coyotes with lice were collected in Michigan in 1979 and 1981. One coyote from Idaho, another from Washington in 1976, and a single wolf near the Manitoba–Saskatchewan border in 1983 had lice.

Although lice are found among several packs across the wolf's range in Minnesota, biologists do not consider them to be a population or management problem there. Controlled trapping of wolves around livestock operations by Wildlife Services (USDA) indicates that only 5–10% of the animals are infested with lice. Minnesota biologists believe the behavior of wolves isolates their packs and may be a factor in limiting the spread of lice (William Berg, Minnesota DNR furbearer biologist, pers. commun.). They also believe it is possible that wolves in Minnesota have developed some level of immunity to the effects of lice. The state takes no action to treat infested packs.

Wild Canids and Lice in Alaska

When and how lice first arrived in Alaska is highly speculative. The best guess is that lice were introduced to wild canids from contact with domestic dogs. In most Alaskan communities, there are a large number of dog kennels, dogs that are allowed to run free and feral dogs that often have lice and occasionally come in contact with coyotes and wolves.

The biting dog louse was first identified on a coyote and then on several wolves harvested in Game Management Unit (Unit) 15A on the Kenai Peninsula during the winters of 1981–82 and 1982–83. Lice were found on 11 wolves among 4 packs in 1981–82 and on 10 wolves among 5 packs in 1982–83 (Schwartz et al. 1983). Fourteen of those 21 infested wolves were pups. Louse

density on infested areas of 5 pups ranged from 2 to 8 lice/cm^2. Pups seemed most affected but all infested wolves had hair breakage and loss, seborrhea, dandruff, and lesions, which were most extensive between the shoulders and in the groin (Schwartz et al. 1983). Although all had heavy infestations, most of the 11 wolves initially examined after the outbreak of lice on the Kenai were in good physical condition (Schwartz et al. 1983). The only animal in poor condition was a pup with no visible fat reserves. No additional morbidity or mortality was observed, but department staff became concerned that heavily infested wolves would be more susceptible to disease and cold temperatures and commercial value of their pelts would drop significantly (Schwartz et al. 1983).

Except for the possibility that some heavily infested wolves died from exposure to severe cold, the louse infestation among Kenai wolves does not seem to have restricted reproduction or survivorship. Wolves recolonized the Kenai Peninsula during the 1960s, after being extirpated there 25 years before, and by 1975 had repopulated most of the suitable habitat (Spraker 1997). The population increased rapidly, mainly because of a high-density moose population, and has remained at 180–200 animals since 1981–82. Pups have comprised over 1/3 of the fall population. Wolf distribution has increased over the past 20 years on the Kenai. There are estimated to be 45 wolves among 6 packs in Unit 7 and 155 wolves among 14 packs in Unit 15 (Spraker 1997). Wolf packs are now found across Kachemak Bay down to the southern tip of Unit 15C. However, their numbers and distribution are not consistent over time. Wolf survival on the southern portion of their range is low, which could be due to low numbers of moose and lack of caribou. Spraker (1997) reported that natural mortality rates have been low among Kenai wolves but may be increasing due to high wolf densities and declining prey populations. Trappers and hunters annually harvested 2–12 wolves in Unit 7 and 5–17 wolves in Unit 15 between 1991–92 and 1995–96. The harvest in 1996–97 was 30 for the entire Kenai (Hicks 1997). An agreement with the U. S. Fish and Wildlife Service allows wolf harvest management on a quota system in Unit 15A. Spraker (1997:37) concluded the recent wolf harvest of 15% of the fall population was low and that "the wolf population will probably be controlled by prey abundance, increased dispersal, and natural mortality."

During the winter of 1991–92, a radiocollared wolf was reported in the Knik River valley of Units 14A and 14C, northeast of Anchorage. The wolf was identified as a Kenai wolf, and she and her mate both exhibited frequent shaking and scratching typical of louse-infested animals. The 2 wolves were captured and treated with ivermectin. Subsequent inspection of trapper-caught wolves from that pack indicated a successful cleansing effort.

During the winter of 1992–93, the department initiated a statewide effort to evaluate the extent of infestation by lice in wolves and coyotes. Our goal was to inspect all harvested wolves submitted for sealing. If the department believed the infestation was limited to the Kenai Peninsula, the strategy would be to attempt to confine the infestation there. No evidence of lice was found elsewhere during the evaluation. Furthermore, no subsequent sightings of louse-infested wolves off the Kenai Peninsula were reported until the winter of 1998–99.

In November and December 1998, trappers reported catching wolves and coyotes with evidence of lice between Willow and Talkeetna in the lower Susitna River valley. Department staff speculated on the extent of infestation and its potential rate of spread and deliberated the

feasibility of success in treating infested animals with ivermectin. The decision was made to commit funds and staff to investigate the infestation and then treat or remove infested packs if necessary. Our experiences with infestations in the Kenai packs suggested that if even 1 wolf escaped treatment, its pack would become reinfested and the control effort would fail.

LIMITATIONS TO CURRENT KNOWLEDGE

Several biological and social concerns regarding louse infestations in wild Alaskan canids were identified where our knowledge is limited. The following items incorporate (1) topics presented in the available literature, (2) experience gained through research and management activities by department staff, and (3) some of the ideas suggested by Dr. Walter Boyce, a specialist in wildlife ectoparasites from the University of California at Davis who provided analysis and recommendations at the division's request (Appendix B).

Biological Concerns

- Sources and mechanisms of louse transmission: Is the Mat–Su infestation an example of a low-frequency transmission rate that can potentially be controlled, or is this an indication that conditions are now right (e.g., wolf populations are dense enough or the climate has changed enough, etc.) to allow rapid transmission of the infestation northward?
- Extent of infestation among wolves, coyotes, and domestic or feral dogs (including wolf–dog hybrids)
- Level of interaction among wolves, coyotes, and dogs
- Influence of wolf population growth rates and pack stability on the spread of lice
- Survival and reproductive success of louse-infested animals: Will Interior wolves be affected similarly to Kenai wolves (e.g., low mortality, chronic infestation, no or slow rate of adaptation)?
- Susceptibility of individuals to infestation and the influence of disease and suppressed immune systems in wild canids on their vulnerability to lice
- Ability of lice to live in colder, dryer climates
- Genetic variability among lice affecting wolves, coyotes, and dogs

Social Concerns

- Ability of the division to influence dog owners and public agencies to take action to greatly reduce or eliminate the prevalence of lice among domestic and feral dogs
- Level of public concern about the esthetic and monetary value of wild canids that may be lost due to lice
- Level of public concern about the use of different options for eliminating louse infestations among wild canids in the state

LOUSE CONTROL EFFORTS

Most of the material in this section is from a paper presented to the 1999 Annual Meeting of the Alaska Chapter of The Wildlife Society by Herman J. Griese, Ted H. Spraker, and Mark A.

Masteller, entitled Recent attempts to arrest the spread of *Trichodectes canis* among wild canids in Southcentral Alaska.

Initial Efforts

In response to the initial infestation of wolves and coyotes on the Kenai Peninsula during the winter of 1981–82, the department proposed to identify and eliminate all infested packs there, which was the course of action recommended by several ectoparasitologists. However, this proposal followed attempts by the department to enact wolf control programs in Interior Alaska, and a vocal segment of the Anchorage public claimed it was a "smoke screen" to hide our continuing attempt to eliminate wolves. Subsequently, the Commissioner and Governor withdrew the option to kill infested wolves, forcing the department to use other measures to control or eliminate infestation.

During February 1983, ivermectin (an antiparasitic drug from Merck & Co., Inc. developed to eliminate ectoparasites in horses and cattle) was identified as a possible treatment for louse-infested wolves and coyotes (Taylor and Spraker 1983). When administered orally, subcutaneously, or intramuscularly at twice the recommended dosage, ivermectin eliminated the adult lice and any hatching nymphs before the lice could reproduce. Ivermectin was tested on 3 infested wolves held in captivity and was determined to be a possible alternative to killing the infested packs (Taylor and Spraker 1983). However, the efficacy of treating wolves and coyotes in the field had yet to be tested. Because the duration of the drug's action was limited to 6 months, it was uncertain whether wolves would become reinfested before all affected animals were treated.

Wolves from the 5 infested packs were captured from a helicopter and treated with intramuscular injections of ivermectin in March 1983 (Taylor and Spraker 1983). Baits treated with the liquid form of ivermectin were also scattered in the area at sites of wolf-killed moose. Although treatment with ivermectin appeared to rid at least some of the infested animals of lice, capturing and treating wolves proved ineffective because infested packs were relatively large (up to 18 individuals) and not all pack members could be caught. The treated baits were also of limited value because of the relatively small scope of their coverage and their consumption by nontarget species. Because of the lack of success in stopping the spread of the louse infestation and the significant staff time and resources already invested in the program, funding was stopped after the second winter (1983–84).

Subsequently, the lice rapidly spread to wolves in Unit 15C, then Unit 15B, and eventually Unit 7. An attempt to eliminate the initial foothold of lice in Unit 7 by trapping and treatment was successful but for only a short time. By the early 1990s, it was believed all known packs on the Kenai Peninsula were infested with the biting louse.

Recent Efforts

The most recent louse infestation was localized along the George Parks highway between Willow and Talkeetna, within the drainage of the lower Susitna River in Units 13E, 14A, 14B, 16A, and 16B. The area was bounded on the east by the Talkeetna Mountains, on the south by Knik Arm, on the west by the Yenlo Hills, and on the north by Denali State and National Parks. The source

of this new infestation was unknown, but it is possible that the wolves were infested from domestic dogs.

Methods

A reconnaissance of the area was made during 4–8 January 1999 and 3 wolf packs were inspected from fixed-wing aircraft. During 19–22 January wolves were captured using 2 Robinson-22 helicopters, each accompanied by 2 spotter aircraft. The objective was to capture at least 1 wolf from each pack in the study area but to strive for 1 adult and 1 pup in each pack.

Wolves were darted using Telazol®, which is a commonly used immobilizing drug for wolves. At least 1 wolf from each pack was radiocollared and every animal handled was treated with ivermectin at a dosage of approximately 20 mg/100-lb wolf. Numbered tags and flagging was attached to the ears of all wolves caught to aid in identifying treated pack members. Each captured animal was inspected for lice, and samples of hair, blood, lice, and louse egg casings were collected.

During 25–30 January all wolves in each infested pack were captured and treated. Each pack was radiotracked 1–9 times in the subsequent 6-week period to ensure that all infested wolves were treated.

In February and March 1200 treated baits were distributed in the area of infestation. Baits consisted of 3–6 ounces of moose meat injected with 10 mg of ivermectin in paste form. The goal was to reach coyotes and any lone wolves not previously captured and treated. Wildlife Services of U.S. Dep. of Agriculture was contracted to assist in distributing baits and to live-capture as many coyotes as possible within the area of the infested packs. Local trappers were relied upon heavily to disperse the baits and to observe the wolf packs for signs of infestation. Trappers were also questioned on the number and locations of louse-infested coyotes caught.

Results

Wolves. Through the end of January, 14 packs containing a minimum of 135 wolves were found and evaluated (Table 1). In the evaluation phase (19–22 January 1999), 20 wolves from 10 packs were captured and handled and 3 of the 14 packs were verified with lice. One female from the Sheep River pack, died as a result of capture efforts. Eleven wolves were radiocollared.

The infested packs included the Willow Mountain pack, the Montana Creek pack, and the Deshka River/Moose Creek pack (Fig. 1). During 25–30 January 27 of the 34 wolves in the 3 packs were treated (Table 1). An adult female in the Willow Mountain pack also died as a result of capture efforts. At the time it was believed all but 1 member of the 3 infested packs had been captured. A single wolf, observed in the Montana Creek pack during 19–22 January, could not be found during the capture and treatment period.

Nine separate visits to the Montana Creek pack were made over the next 6 weeks to find the remaining untreated wolf. During those visits, the pack declined to 2 adults. A trapper presented a wolf for sealing that he had trapped just inside the adjoining Kashwitna River pack territory.

The wolf was unmarked and was infested with lice. This may have been the missing Montana Creek pack member.

Trappers also caught 2 additional infested, unmarked wolves in or near the Deshka River/Moose Creek pack territory. Because of this pack's large size and because tracks of 2 single wolves were observed within this territory, these 2 wolves were probably the 2 lone, untreated members of that pack.

Trappers provided wolf pelts for evaluation from 2 additional packs of the original 14, the Little Susitna–Pt. Mackenzie pack and the Lake Creek pack; these pelts were free of lice. The 2 remaining packs, Upper Yentna River and Kahiltna Glacier packs, were observed at close range from the air and seemed healthy.

By the end of the required pelt sealing deadline (30 April 1999) at the end of the trapping season, trappers presented pelts of 14 wolves from 6 other packs in the general area, and these animals were all free of lice (Table 1). Based on observations and harvests by trappers, 34 wolves were estimated to have lice in the Mat–Su Valley before treatment began. Twenty-seven wolves from the 3 infested packs were treated. Trappers caught 7 more infested wolves, 3 of which were taken after treatment. Thirteen additional uninfested wolves were treated during 19–22 January 1999 (Table 1).

Blood samples were collected from wolves captured during the 1999 treatment program in the Mat–Su area. Serologic tests were conducted for selected disease agents, and antibody prevalence was high for canine parvovirus (18 of 27 wolves tested) and canine corona virus (19 of 27 wolves tested). These values were higher than those found in previous surveys. However, they were comparable with data from other regions of Alaska during the late 1990s. There was no apparent relationship between antibody prevalence for these viruses and louse infestation.

Coyotes. Fourteen active trappers within the study area were questioned and 36 coyotes were evaluated for lice. Although not all of those coyotes were available for inspection, up to 6 of them may have been infested. Department staff confirmed lice on 4 coyotes.

Of note was a coyote that had been killed 26 hours earlier and stored overnight in subfreezing temperatures. Upon inspection most (6 of 7) lice were found still alive on the partially frozen carcass. It had previously been assumed lice would survive only a few hours in freezing temperatures following the death of the host (Turner 1971).

Coyotes readily discovered and consumed the ivermectin-treated bait distributed along roads, trails, and waterways (Fig. 2). In many cases individual coyotes consumed several baits.

Attempts to live-capture coyotes proved unsuccessful. Many of the coyotes had become shy of traps and snares by the end of the trapping season.

Conclusions

It was believed all organized packs were identified and that approximately 90% of the infested wolves in the Mat–Su Valley study area had been treated. Trappers may have captured most of

the remaining infested wolves. The 3 infested wolves trapped after treatment are hoped to represent the only remaining untreated individuals. It is believed the infestation was beyond its first year of development, because the posttreatment captures of infested wolves outside territories of treated packs indicated wolves had already dispersed from infested packs.

It is possible there was wolf mortality caused in part by infestation of lice. The disappearance of the 2 younger wolves from the Montana Creek pack followed a period in which temperatures remained below –40 °C for a number of days. Such mortality would probably be restricted to pups and yearlings. Adults in fair to good physical condition tend to exhibit less hair loss and thus are less prone to mortality from exposure. Adults in poor condition can have hair loss as severe as pups.

It is unclear why lice have infested virtually all wolf packs on the Kenai but relatively few coyotes. In contrast, in the Mat–Su Valley, initial surveys estimated 10–20% of the coyotes in the study area were infested. This level is well above that observed on the Kenai Peninsula over the past 17 years.

As on the Kenai Peninsula, the suspected origin of the Mat–Su Valley infestation was from free-roaming domestic dogs. The potential for interaction between dog and wild canid has increased substantially in the last 2 decades. As people settled in the valley, they often sought remote locations along the main highway corridor to avoid municipal restrictions (such as leash laws). The concurrent elimination of same-day airborne hunting and an abundant moose resource enhanced the growth of the wolf population. It is also possible that coyotes served as intermediate hosts.

The cost of the effort in the Mat–Su Valley was approximately $60,000 in operational expenses, not including the time of several staff.

PROJECTED EFFECTS IF NO CONTROL EFFORT IS IMPLEMENTED

This is a difficult topic to address because of the lack of empirical data to support projections. The rapid spread of lice among wolves on the Kenai and the recent outbreak in the Mat–Su Valley raises serious concerns that a similar infestation can happen elsewhere in the state. It is well known that dogs throughout Alaska are infested with lice in a low-level enzootic stage (Zarnke 1985; William Taylor, ADF&G veterinarian, pers. commun.). However, the potential for dogs to transmit lice to wild canids around communities away from the road system may be minimal because wolf harvest there tends to be high. Dispersing Southcentral wolves and coyotes may be a bigger potential factor than domestic or feral dogs in the spread of lice to wild canids in the Interior. The tendency of wolf packs to isolate themselves from one another may help restrict the spread of lice as long as wolves do not come into contact with dispersing, infested animals. Zarnke (1985) found that lice did not establish a chronic infestation in an experiment to infest 4 captive wolves in Fairbanks with lice, which were obtained from free-ranging wolves on the Kenai Peninsula, although he found lice on captive wolves for 2 months following exposure. This study indicated lice were not as easily transmitted between animals as believed.

The spread of lice to Interior coyotes and wolves, in particular, could have a significant economic effect on trappers because of lost pelt value. In those areas where trapper incentive is reduced, the department would have to reassess ungulate management goals and develop new strategies to manage predators. Louse-infested wolves in Denali National Park would certainly affect the quality of wolf viewing.

The relationships between parasites and their hosts can be complex. Generally, hosts and parasites in well-established relationships have adapted so that neither is seriously harmed by the other. However, parasites that are not endemic to an area are more destructive to new hosts that have never encountered the parasite before (Chandler 1954). This seems to be the case with wild canids and lice in Alaska. Immune responses (whether cellular- or antibody-mediated) by wolves and coyotes may be a factor and play a significant role in their relationship with lice. Wolves and coyotes in Alaska may be suffering from acute allergic reactions to antigens from lice that may diminish over time as the canids and lice adapt to each other. However, heavy infestations, especially coupled with poor body condition, can inhibit the development of an improved immune system and allow further infection (Chandler 1954). Based on our limited observations of the Kenai infestation, it will likely take a significant number of generations of wolves and coyotes to develop an adaptive response that limits the effects of lice on their populations. Environmental conditions may not be severe enough on the Kenai Peninsula to significantly reduce the condition or fitness of heavily infested wolves and coyotes, thus preventing a selection against the condition. This may explain the lack of response by wild canids on the Kenai over the past 18 years. It can be speculated that the harsh winter conditions in the Interior would provide sufficient stress on infested animals to allow adaptation to proceed more rapidly.

With the spread of lice, we may see higher morbidity of wolves and coyotes, particularly among young animals. Animals already food-stressed or otherwise in poor condition will probably be more susceptible to disease and cold if they are also heavily infested with lice (Schwartz et al. 1983). However, there is no evidence of direct mortality from lice or of a negative population effect from lice on wolves or coyotes in Alaska or the lower 48 states.

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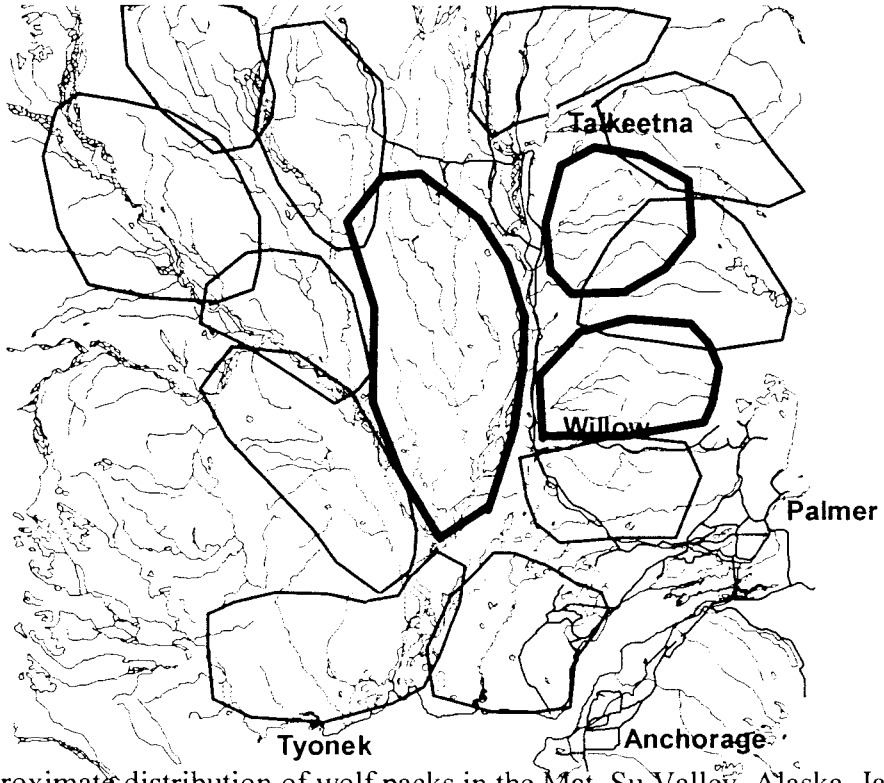

Figure 1 Approximate distribution of wolf packs in the Mat–Su Valley, Alaska, Jan–Feb, 1999. Heavy black lines delineate louse-infested packs.

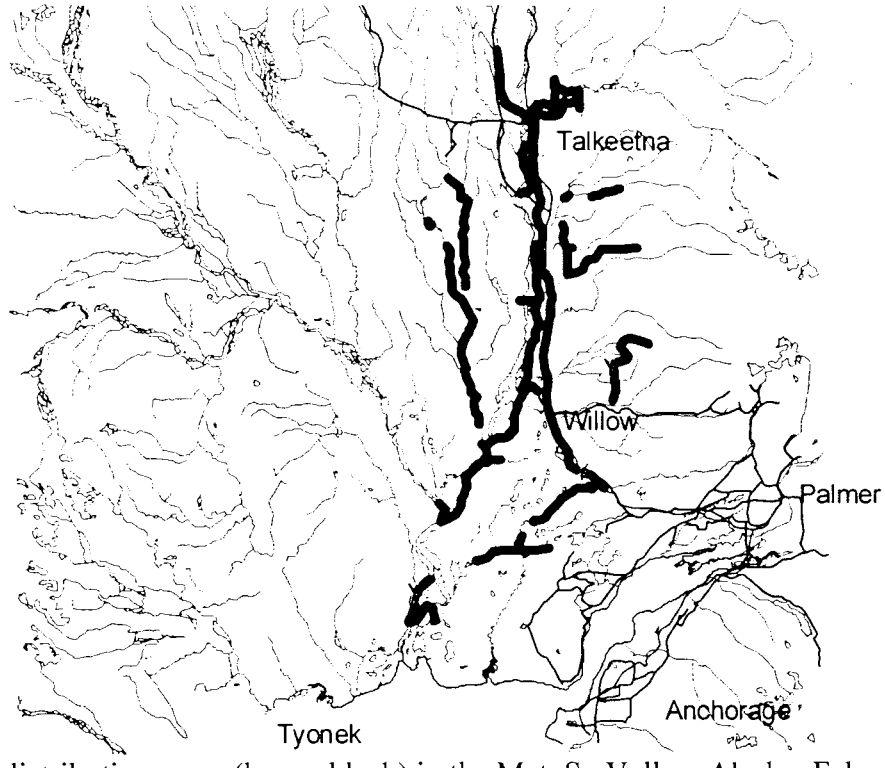

Figure 2 Bait distribution areas (heavy black) in the Mat–Su Valley, Alaska, Feb–Apr, 1999.

Table 1 Status of wolf packs that were examined and treated for lice in Game Management Units 13E, 14A, 14B, 16A and 16B, Alaska, December 1998–March 1999. Infested packs are shown in bold type.

Pack Name	Unit	Initial Pack Size	Observed Condition	Captured And Treated	Capture Mortality	Harvest by Trappers Before Treatment	Harvest by Trappers After Treatment	Pack as of 15 May
Packs found and evaluated before the end of trapping season								
Little Susitna/Point Mackenzie	14A	4	Clean	0	0	0	3	1
Bald Mountain	14A	5	Clean	2	0	0	4	1
Willow Mountain	**14B**	**14**	**Infested**	**12**	**1**	**2**	**1**	**8**
Kashwitna River	14B	16	Clean	1	0	0	0	16
Montana Creek	**14B**	**6**	**Infested**	**4**	**0**	**1**	**1[a]**	**2–4[b]**
Sheep River	14B	5	Clean	2	1	0	0	4
Chunilna Creek	13E	5	Clean	2	0	0	3	2
Kahiltna Glacier	16A/B	2+	Clean[c]	0	0	0	0	2+
Kahiltna River	16A	9	Clean	2	0	0	0	9
Deshka River/ Moose Creek	**16A**	**14**	**Infested**	**11**	**0**	**1**	**3[d]**	**10**
Upper Yetna River	16B	6	Clean[c]	0	0	0	0	6
Lake Creek	16B	12	Clean	0	0	3	5	4
Alexander Creek	16B	17	Clean	2	0	0	0	17
Theodore River	16B	20	Clean	2	0	1	4	15
Total		135		40	2	8	24	97–99
Adjacent packs evaluated by the end of trapping season[e]								
Portage Creek	13E	14	Clean	0	0	0	1	13
Knik River	14A	5–6	Clean	0	0	2	2	1–2
Granite Creek	14A	?	Clean	0	0	0	1	?
Prairie Creek/ Talkeetna River	14B/13E	15	Clean	0	0	0	3	12
Yellow Jacket Creek/ Beluga River	14B/13E 16B	16 5	Clean Clean	0 0	0 0	0 0	3 2	13 3
Total		55–56		0	0	2	12	42–43

[a] A trapper caught a louse-infested wolf after treatment in the territory of the Kashwitna River pack, but we believe it was from the Montana Creek pack.
[b] We suspect the mortality of 2 pups or yearlings that disappeared after extreme cold temperatures.
[c] Louse infestation was determined from aerial observation.
[d] Two wolves captured after treatment were unmarked and had lice.
[e] Hides of trapped wolves were inspected for lice.

Appendix B. Transcript of analysis and recommendations of Dr. Walter Boyce concerning the infestation of biting lice in Alaskan canids. Dr. Boyce is Associate Professor and Associate Parasitologist in the Department of Pathology, Microbiology, and Immunology at the University of California at Davis. He has extensive experience with ectoparasite-host relationships. His special interest is in ectoparasitic mites and bighorn sheep.

> After reviewing the materials you sent me, and based on our phone conversation, I have put together my thoughts on what you need to know, and how you might gain the answers you need.
>
> Major unknowns and management implications:
>
> 1. What effect do lice have on survivorship and reproductive success?
>
>   If no effect, then no need to manage. If lice do have negative effects, then appropriate management strategies should be explored.
> 2. Are lice on the Kenai genetically similar to those on the mainland?
>
>   If lice are genetically similar on the Kenai and the mainland, then it is likely that there was/is gene flow between the two locations. In other words, we could not reject the hypothesis that the Kenai served as the original source of lice for infested mainland wolves. If the lice are dissimilar, this implies that there were different sources of lice for the two areas. From a management perspective, a single source of lice suggests more opportunities for effective control, whereas multiple sources of lice would be more difficult to manage/eliminate.
>
> 3. Are lice on wolves, coyotes, and domestic dogs genetically similar?
>
>   Essentially an extension of #2 with similar implications. If dogs and/or coyotes share lice with wolves, then management becomes very problematic. If however, louse populations are essentially restricted to different host species (i.e., wolf lice, dog lice, coyote lice), then management is simplified. Knowing the answer to #3 will also provide solid insight into the origin of the wolf infestation on the mainland and Kenai (especially in combination with #2).
>
> 4. Is treatment an effective management tool?
>
>   An essential question given the answers to 1–3 above. Without an effective treatment, management options will be limited. However, it is essential to evaluate the efficacy of treatment since it is all too easy to spend considerable time, money and effort on a less-than-useful treatment program.
>
> My suggestion is to develop and initiate a research and management program that addresses these questions. The design must incorporate testable hypotheses so that every action you take moves you forward.
>
> Hypotheses (null and alternate):
>
> 1. Ho – lice have no effect on survivorship
>
>   Ha – lice significantly decrease survivorship

2. Ho – treatment has no effect on survivorship of infested wolves

   Ha – treatment significantly increases survivorship

3. Ho – wolves are susceptible to reinfestation after successful treatment

   Ha – wolves are not susceptible to reinfestation

4. Ho – treatment has no effect on pack survival and reproductive success

   Ha – treatment significantly increases pack survival and reproductive success

5. Ho – lice on mainland and Kenai wolves are genetically similar

   Ha – lice are not genetically similar

6. Ho – lice on wolves, coyotes, and dogs are genetically similar

   Ha – lice are not genetically similar

Hypotheses 1–4 could be tested in a field study using radiocollared wolves

Hypotheses 5–6 could be tested in the lab with a molecular study of lice

Outcome – the final outcome of the above studies would be definitive answers to questions that have major conservation and management implications (i.e., those identified at the beginning of this document).

LOCATION

GAME MANAGEMENT UNIT: 16 (12,300 mi^2)

GEOGRAPHIC DESCRIPTION: West side of Cook Inlet

BACKGROUND

Prior to the 1900s and the establishment of major human settlements in Anchorage, Palmer/Wasilla and Kenai/Soldotna, wolf numbers in Unit 16 fluctuated with prey densities. Since 1900 wolf populations have been heavily influenced by various human harvest regimes. These have ranged from predator-control strategies (including the use of poison, bounties, and aerial shooting) prior to statehood to relatively restrictive regulations including only trapping and sport hunting (Harkness 1991, Masteller 1994).

Reports from trappers, pilots and staff indicate wolf numbers began increasing in the early 1990s. The first systematic population estimate of wolves in Unit 16 occurred in March 1993, during the development of the Sample Unit Probability Estimator (Becker et al. 1998). At that time we estimated there were 48–62 wolves, in 8–10 packs, in this area. The population has more than doubled since that survey.

During November and December 1998 trappers caught several wolves (and coyotes) in the lower Susitna Valley (Units 16A and 14B) that were infested with the dog-biting louse *Trichodectes canis*. This was the first time lice had been confirmed in Alaskan wolves outside the Kenai Peninsula, where louse-infested wolves were first seen in 1981. The source of the recent infestation was unknown, but we suspect feral dogs or wolf-hybrids near the Parks Highway corridor. During January 1999 we mounted a large effort to treat infested wolves in the Susitna Valley, to prevent the spread of lice to other areas of the state. Our efforts revealed 1 pack in Unit 16A (and 2 adjacent packs in Unit 14B) were infested. We attempted to capture and treat all infested wolves with the antiparasitic drug ivermectin (Merck & Co, Inc.). We also distributed medicated baits, meant to treat coyotes, dogs and lone wolves. However, we were unsuccessful in eliminating lice from area wolves, as 6 louse-infested wolves (including 2 that had previously been treated) were trapped or found dead in Unit 16 during winter 1999–2000. These wolves were distributed from the lower Beluga River north to the West Fork of the Yentna River, and east to the Susitna River.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

The goal for this area is to conserve the wolf population, retain desirable predator/prey ratios, and provide a sustainable harvest of wolves.

MANAGEMENT OBJECTIVES

The population objective is to maintain a wolf population of 30–60 wolves in at least 4 packs. This should include 8–15 wolves (in 1–3 packs) in Unit 16A and 22–45 wolves (in 3–5 packs) in

Unit 16B. The human-use objective is to allow maximum opportunity for harvest while maintaining minimum wolf population objectives.

METHODS

During 1996–97 and 1997–98 we estimated wolf numbers, distribution, and population trends based on observations by staff, trappers, hunters, and pilots, and from interviews with trappers and hunters sealing fur from Unit 16. During 1998–99 numbers were estimated during our effort to control the lice infestation in the area. Annual wolf harvest was determined by sealing all wolves presented for examination.

With the unanticipated discovery of louse-infested wolves in this area, and the fear the infestation would move north, we met with staff from headquarters and regions 2 and 3 to discuss management options, political considerations and funding strategies. We decided that area staff would use non-lethal means to attempt to eliminate lice from Susitna Valley wolves and coyotes, employing a capture/treatment program for wolves and distribution of medicated baits for coyotes. Additionally, regional staff would attempt to treat domestic dogs in the Parks Highway corridor.

We enlisted the aid of several other area biologists in our effort to capture and treat all infested wolves in the Susitna Valley. We used aerial reconnaissance from Piper PA-18 aircraft to first locate and examine wolf packs, then we captured 1–2 wolves in each pack to confirm the presence or absence of lice. We captured and treated all known members of the infested packs, using 2 capture crews with 2 Robinson R-22 helicopters. Wolves were immobilized using Telezol, and ivermectin was administered to rid wolves of lice. We also distributed approximately 1200 meat baits, containing ivermectin paste, in the general area occupied by infested packs, to attempt to medicate coyotes and lone wolves potentially missed during our capture operation. Radiocollared wolves were tracked periodically to visually assess pelt characteristics and whether all pack members had been treated. No efforts were made to treat domestic pets in the affected area. The louse control effort is outlined completely in Golden and others (2000, Unit 14 Appendix A).

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

Unit 16 contained an estimated 120–140 wolves, in 16–19 packs, during fall 1998 (Table 1). This is approximately twice the number estimated during February 1993. The large increase in recent years is probably an artifact of our methodology and resources. The effort to control the spread of lice allowed us to get reliable minimum estimates of pack sizes and distribution in a large portion of Unit 16, and the resulting numbers were substantially higher than previous estimates in those areas. This demonstrates that the "traditional" method of estimating wolf populations solely from incidental observations by staff, trappers, pilots and other outdoor enthusiasts probably results in a significant under-estimation of wolf numbers. Further, we may be able to detect only large population shifts through traditional methodology.

I believe wolf numbers have steadily increased since the early 1990s, probably due to relatively high prey abundance, low rate of legal harvest, lower levels of illegal harvest, high wolf densities in adjacent areas, and several deep-snow winters, which increased prey vulnerability.

Distribution and Movements

Wolves inhabit most portions of Unit 16 (Table 2). Several packs utilize portions of other units. Territory boundaries can be very fluid over time, depending on factors such as wolf and prey density (Mech and others 1998)

Diseases/Parasites

Of 7 packs examined during the louse-control effort in Units 16, only 1 pack (Deshka River) was confirmed to have lice. An additional pack (Beluga River), evaluated by inspecting the hides of wolves taken by trappers or hunters, did not appear infested (Golden and others 2000, Unit 14 Appendix A). We captured and treated 11 wolves in the Deshka River pack and 2 wolves each in the Kahiltna River, Alexander Creek and Theodore River packs. The Kahiltna Glacier and Yentna River packs were classified as "clean" based on aerial observations only. The operational cost of the louse-control effort was $60,000 (including both Units 14 and 16). Because coyote and domestic/feral dogs (including hybrid wolves) are known to harbor lice, it is very difficult to totally remove lice from the area.

MORTALITY

Harvest

Season and Bag Limit. During the report period the hunting season for Unit 16 was 10 August–30 April, with a bag limit of 5 wolves. The trapping season was 10 November–31 March, with no bag limit.

Board of Game Actions and Emergency Orders. During June 1993 the Board of Game authorized same-day-airborne shooting of wolves, provided the person attempting to take the wolf had a trapping license and was at least 300 feet from the airplane. During November 1996 this method of take was prohibited through a statewide ballot referendum (effective 25 February 1997), so this method of take was legal during only a portion of the report period. For additional board action regarding wolf hybrids, please see the Unit 14 portion of this report.

Hunter/Trapper Harvest. Harvest averaged 25 wolves per year during 1996–1999 (Table 3), continuing an increasing trend since the late 1980s. During 1988–93 annual harvest averaged 7 wolves (Masteller 1994), and during 1993–96 annual averaged of 18 wolves (Masteller 1997). The proportion of wolves taken by shooting ranged from 31–54% in recent years, and was highest during the season when regulations allowed hunters to shoot the same day they had flown. The total number of trappers/hunters has generally been increasing, probably due to increases in human population, improvements in snowmachines and steady wolf pelt prices. However, the harvest can fluctuate significantly based on the efforts of a few experienced (and aging) wolf trappers.

Harvest Chronology. Most harvest typically occurs between December and March, but fall harvest has increased substantially in recent years (Table 4). As wolves become more numerous, more moose, sheep and caribou hunters report seeing and taking wolves. Winter harvest chronology is greatly affected by snow conditions.

Transport Methods. Most wolves are taken by people using snowmachines or aircraft to access their hunting or trapping areas (Table 5). The increase in harvest during fall is reflected in the relative increases in the percentage of hunters using boats, 4-wheelers, and aircraft.

HABITAT

Assessment

Moose populations in Unit 16B have been declining for over a decade, while in 16A moose numbers appeared stable (Griese in press). Many hunters report Dall sheep and caribou numbers are declining in the Alaska Range. Hare numbers increased substantially during 1996–1999, and beaver numbers have remained high. Heavy snow conditions in the Susitna Valley during winter 1999–2000 undoubtedly increased both moose vulnerability to wolves and moose starvation, providing plentiful carrion. Human density has increased slightly, but generally there are large areas with few permanent residents. Recreational development continues to increase, with more seasonal-use cabins, boating, and fishing.

CONCLUSIONS AND RECOMMENDATIONS

Our wolf population objective has not been met because we estimate the population is 3–4 times larger than the stated objective, and our objective does not (as in other units) specify a minimum number of wolves. This ambiguity may have important ramifications during intensive management discussions, as some members of the public may conclude we have been negligent by not attempting to hold the population near the objective range. I recommend discussions with local advisory committees and the Board of Game to clarify our population objective.

Our wolf human-use objective has been met, and no regulatory changes are recommended. Harvest rates, which were 15–30% annually during the report period, were well within sustainable rates (Ballard et al. 1987).

The wolf management goals for this area include conserving the wolf population, providing sustainable wolf harvest, and retaining "desirable" predator–prey ratios. With a growing population and relatively low harvest rates, the first 2 goals have been met. However, we have not defined desirable predator–prey ratios. With the increase in wolf numbers and decrease in moose numbers, the number of moose per wolf has declined from approximately 250:1 in 1993 to 70:1 in 1999. The latter is similar to other areas where moose populations were declining or stationary and predation (by both wolves and bears) was the suspected major factor limiting moose population growth (Gasaway et al. 1992). Good summer prey availability, harsh winter conditions increasing moose (and sheep and caribou) vulnerability, and potentially reduced wolf harvest rates because of lice may combine to further increase wolf density.

Managers must consider that Unit 16B is an "intensive management" area for moose and that the area currently supports 3 winter Tier II subsistence moose hunts. In the last decade subsistence hunters have been restricted to taking bulls only where cow harvest had been allowed in the past. As the moose population declines, there will undoubtedly be requests to control wolf populations. It will be important to define "desirable predator–prey ratio" using advisory committee and Board of Game input. If during intensive management discussions there is interest in reducing wolf numbers, it will be difficult to accomplish using current methods and means. The problem will be exacerbated if widespread pelt damage on wolves reduces trapper/hunter effort, further limiting methods for significant wolf harvest.

It is difficult to identify population trends without regular attempts to systematically assess population size. Because of the extraordinary efforts stemming from the louse infestation, we were able to develop a good minimum population estimate to compare with our systematic survey of 1993. It appears the population has at least doubled between 1993 and 1999 and that wolf numbers cannot accurately be estimated using only anecdotal and sealing information. Surveys should be conducted every 3 years to assess wolf numbers. Demographic and distribution information can be determined with simple reconnaissance flights when visibility and snow-tracking conditions are best, using 2–3 aircraft during a short period in early winter. This will require approximately $8,000 and appropriate technical staff time every 3 years. Current methodology (observations by staff, trappers, and the public) should suffice for distribution information.

The spread of the nonnative louse to the Susitna Valley is a very serious concern for managers. Six infested wolves, including 2 that had been treated in January 1999, were trapped in Unit 16 during winter 1999–2000. This indicates we were unsuccessful in eliminating lice from the area and that either ivermectin did not eliminate lice in these wolves, or (more likely) wolves were re-infested from untreated pack mates or feral dogs/hybrid wolves. In one instance an uncharacteristically small, unmarked, heavily-infested "wolf" was trapped on the Yentna River in the southwestern portion of Denali National Park and Preserve. With current high wolf densities, this parasite could spread rapidly within the Susitna Valley. Given natural dispersal rates for wolves (Mech et al. 1998), it is likely that lice will infest wolves in other parts of the state in the near future. Indeed, a wolf from the Deshka River Pack, treated for lice and marked in January 1999, was trapped near the Sanford River in Unit 11 during December 1999. The trapper reported the pelt showed loss of guard hairs between the shoulder blades, a typical sign of lice, but the presence of lice was not confirmed. Please refer to the Unit 14 recommendations for policy-related suggestions regarding louse infestations. Managers in other areas should be prepared to answer public inquiries regarding division policy in this matter.

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Table 1 Unit 16 fall wolf population estimates[a], 1994–98

Year	Population estimate	Packs (nr)	Basis of estimate
1994/95	57–79	11–13	Incidental observations, sealing records, reports from public
1995/96	46–75	11–13	same as above
1996/97	60–85	10–12	same as above
1997/98	75–110	12–15	same as above
1998/99	120–140	16–19	ADFG staff, wolf/lice project

[a] Fall estimate = pre-trapping season population.

Table 2 Probable wolf pack locations, minimum sizes, and sources of information for Unit 16, March 1999

Pack name/Location	Approximate Pack Size	Source
Unit 16A		
Tokositna River[a]	6	ADFG staff during wolf/lice project
Kahiltna River/Peters Hills	10	" "
Kahiltna Glacier	4	" "
Kroto Creek	5	" "
Moose Creek	5	" "
Unit 16B		
Upper Yentna River	8	ADFG staff during wolf/lice project
Lower Yentna/Lower Kahiltna	5	" "
Happy River	5	" "
Johnson Ck, Kichatna River	6	" "
Upper Skwentna River	5	" "
Eight-mile Ck/Talachulitna River	5	" "
Lake Creek	7	" "
Mt. Susitna/Alexander Creek[b]	10	" "
Beluga River	6	" "
Theodore River	15	" "
Chuitna/Chakachamna Rivers	4	Trapper obs., sealing data
Drift River	6	Trapper obs., sealing data
McArthur River	5	Trapper obs., sealing data

[a] Pack probably uses both Units 16A and 13E.

[b] Pack probably uses both Units 16B, 16A and 14A.

Table 3 Unit 16 wolf harvest, 1994–98

Regulatory year	Reported harvest				Method of take			
	M	F	Unk	Total	Trap/Snare	Shot	Unk	Successful Trapper/hunters
1994/95	14	14	0	28	11	17	0	17
1995/96	6	9	0	15	9	6	0	7
1996/97	13	12	1	26	12	14	0	14
1997/98	7	8	1	16	11	5	0	9
1998/99	13	19	2	34	18	16	0	22

Table 4 Unit 16 wolf harvest chronology, 1994–98

Regulatory year	Percent of Harvest							
	Aug.–Oct.	November	December	January	February	March	April	*n*
1994/95	7	0	14	61	11	7	0	28
1995/96	0	13	20	0	33	27	7	15
1996/97	35	4	4	31	15	7	4	26
1997/9	12	6	12	19	38	6	6	16
1998/99	33	3	3	15	27	18	0	33

Table 5 Unit 16 wolf harvest by transport method, 1994–98

Regulatory year	Percent of Harvest								
	Airplane	Dogsled Skis Snowshoes	Boat	3- or 4-Wheeler	Snowmachine	ORV	Highway vehicle	Unknown	*n*
1994/95	18	11	3	0	43	0	7	18	28
1995/96	27	0	0	0	73	0	0	0	15
1996/97	31	4	4	0	54	0	0	7	26
1997/98	12	0	0	0	88	0	0	0	16
1998/99	35	0	9	9	35	0	3	9	34

LOCATION

GAME MANAGEMENT UNIT: 17 A, B, and C (18,800 mi^2)

GEOGRAPHIC DESCRIPTION: Northern Bristol Bay

BACKGROUND

Wolves are common throughout the northern Bristol Bay area; however, we have no objective data on the historic or current abundance of wolves in this area. Harvest data from 1962 to the present provide some indication of wolf distribution and relative abundance, but these data are inconsistent. Bounty records give us a partial record of harvest from 1962 through 1971. Mandatory sealing records from 1972 to the present provide greater accuracy in harvest reporting. In 1988 the department implemented a trapper questionnaire program to collect information on relative abundance of furbearers, including wolves.

MANAGEMENT DIRECTION

MANAGEMENT OBJECTIVES

- Maintain a wolf population that will sustain an annual harvest of 25 wolves

METHODS

We collected harvest data from trappers when they brought their wolf pelts in for sealing. In 1988 we started sending an annual trapper questionnaire to selected trappers in the unit to quantify their observations of furbearer populations during the trapping season and to estimate trends in the populations. We also gained insight into wolf population trends and distribution incidental to moose and caribou surveys, as well as observations from local air taxi pilots.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Trapper reports and general observations indicate that the wolf population continued to increase during this reporting period. Wolf density peaked in Unit 17 from 1974 to 1977 but declined sharply by 1980. Rabies may have been a contributing factor. Densities seemed to increase again until 1989 when another rabies epidemic affected canid populations in the unit. Wolf populations began to increase again in 1992.

Population Size

The estimated 1998 fall wolf population in Unit 17A was 22–28 wolves in 6 to 8 packs; the Unit 17B population was 225–270 wolves in 16 to 22 packs; and the Unit 17C population was 110–165 wolves in 10 to 16 packs (Table 1).

Distribution and Movements

Wolves are present throughout the unit. Highest densities are along the major drainages of the Nushagak and Mulchatna Rivers. There is no evidence of transitory packs that follow the

Mulchatna caribou herd, although lone wolves are occasionally seen with the herd as it pioneers new areas. Packs have established territories and take advantage of caribou when they move through those territories.

MORTALITY

Harvest

Season and Bag Limit.

Hunting:	Unit 17	5 wolves	August 10–April 30
Trapping:	Unit 17	No Limit	November 10–March 31

Board of Game Actions and Emergency Orders. The Board of Game restricted the bag limit for hunters from 10 to 5 wolves starting in the 1992–93 regulatory year. This action resulted from a statewide proposal and was not precipitated by biological concerns specific to wolf populations in Unit 17.

Statewide regulations affecting same-day-airborne shooting of wolves fluctuated between 1991 and 1993. During 1991–92 all same-day-airborne trappers were required to affix a metal locking tag to wolves as soon as they were harvested. In 1992–93 same-day-airborne trapping was prohibited. Starting in the 1993–94 season, same-day-airborne trapping was reinstated, but trappers were required to be more than 300' from their aircraft before shooting a wolf. In 1996 a referendum was passed prohibiting the take of wolves same day as airborne. In late winter of 1996–97, taking wolves the same day as airborne became illegal.

Hunter/Trapper Harvest. The wolf harvest in Unit 17 fluctuates greatly from year to year and is probably greatly dependent upon winter travel conditions. The past 5 year (1994/95–1998/99) annual average harvest (80) was twice the 1995–96 reported harvest of 41, but considerably less than the 1997–98 reported harvest of 107 (Table 2). During 1996–97, 24 hunter/trappers reported taking 53 wolves (35 males, 15 females, 3 sex not reported), with 12 taken in Unit 17A, 33 from 17B, and 8 taken in 17C. During 1997/98, 39 hunter/trappers reported taking 107 wolves (71 males, 35 females, 1 sex not reported), with 3 taken in Unit 17A, 56 from 17B, and 48 taken in 17C. During 1998–99, 39 hunter/trappers reported taking 78 wolves (50 males, 28 females), with 14 taken in Unit 17A, 38 from 17B, and 26 taken in 17C. Most were taken with firearms.

Harvest Chronology. Harvest chronology has been quite variable yearly. Most wolves were harvested in January and February (Table 3). In most years, harvest chronology reflects the suitability of snow conditions for tracking and travel rather than the availability of wolves. Harvest of wolves incidental to moose and caribou hunting activities during August and September has increased during the past few years, the result of increased numbers of hunters and wolves.

Transport Methods. Before 1992, aircraft were the most common means of transport of wolf hunter/trappers in Unit 17 (Table 4). With the prohibition of same-day-airborne taking of wolves in 1992–93 and after 1996–97, most wolves have been harvested by hunter/trappers using

snowmachines for transportation. The advent of larger, more reliable snowmachines has contributed greatly to the use of these machines when hunting and trapping wolves.

CONCLUSIONS AND RECOMMENDATIONS

Few data are available to interpret the status of the wolf population in Unit 17. General observations and public contacts suggest that the wolf population is healthy and is rebounding from the apparent decline from 1989 through 1992. Moose are the primary large prey for most packs in the unit, and moose populations have been stable to increasing throughout the unit since the late 1980s. Although no packs are known to follow the Mulchatna caribou herd in Unit 17, most wolves appeared to take advantage of this rapidly increasing herd as they moved through their territories. It is logical to expect wolf populations to increase along with the prey densities. There is also movement into Unit 17 by wolves emigrating from Units 9 and 19.

The apparent cause of declines in wolf numbers in the late 1970s and late 1980s is unknown but rabies was suspected. There is no evidence that human-induced mortality was the cause of these declines. Rabies is endemic to fox populations in southwestern Alaska, and red fox populations are greatly influenced by periodic epidemics. One rabid wolf was confirmed from the unit in 1981. Samples from 6 wolves that were trapped in Unit 17 area in 1991–92 were sent to the Alaska State Virology Laboratory for rabies tests. All were negative; however, the tests could not determine if the wolves had been exposed to rabies at one time and survived.

Same-day-airborne shooting of wolves was historically a common and effective method of harvesting wolves in Unit 17. Department records confirm this from 1961–62 through 1991–92 and local residents have documented extensive use of aircraft by wolf hunters back to the 1930s. Prohibition of same-day-airborne wolf shooting in 1992–93 resulted in a shift to snowmachines for access. Recent developments in snowmachine technology have improved their effectiveness for assisting in wolf harvests.

If snow conditions are favorable, trappers are able to affect wolf numbers in Unit 17. This was evidenced in the winter of 1994–95, when excellent travel conditions resulted in a record harvest and an apparent reduction in the wolf population. Because of the relatively good accessibility, the abundance of hunters/trappers in the unit, and the health of the ungulate populations, no department-sponsored wolf reductions are recommended for Unit 17 at this time.

Aerial surveys of Unit 17 are needed to better quantify population density. Nearly constant winds cause fresh snow to drift rapidly, however, and good survey conditions seldom last more than 1 day. Survey efforts should be coordinated with department personnel in Units 9 and 19 to maximize the area surveyed while good conditions last.

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Table 1 Unit 17 fall wolf population estimates[a, b], 1991/92–1998/99

Year	Population estimate	Number of packs
1991/92	200–250	20–30
1992/93	250–350	20–30
1993/94	300–350	25–35
1994/95	400–475	30–40
1995/96	320–425	30–42
1996/97	320–425	30–42
1997/98	350–465	32–46
1998/99	350–465	32–46

[a]Fall estimate = pre-trapping season population.

[b]Estimates based on trapper questionnaire, incidental observations during moose and caribou surveys, and harvest data.

Table 2 Unit 17 wolf harvest, 1991/92–1998/99

Regulatory year	Reported harvest				Method of take (%)			Successful hunter/ trappers
	Male	Female	Unk	Total	Trap/snare	Shot	Unk	
1991/92	20	9	8	37	9 (24%)	28 (76%)	0 (--)	20
1992/93	12	5	2	19	4 (21%)	15 (79%)	0 (--)	14
1993/94	29	16	10	55	0 (--)	55 (100%)	0 (--)	21
1994/95	75	35	11	121	33 (27%)	88 (73%)	0 (--)	34
1995/96	26	15	0	41	15 (27%)	26 (63%)	0 (--)	18
1996/97	35	15	3	53	9 (17%)	44 (83%)	0 (--)	24
1997/98	71	35	1	107	17 (16%)	86 (80%)	4 (4%)	39
1998/99	50	28	0	78	9 (12%)	68 (87%)	1 (1%)	39

Table 3 Unit 17 wolf harvest chronology percent by time period, 1991/92–1998/99

Regulatory year	Harvest period						
	December	January	February	March	April	Unknown/Other	n
1991/92	5%	32%	30%	22%	--	11%	37
1992/93	5%	21%	53%	11%	--	10%[a]	19
1993/94	22%	27%	16%	26%	4%	6%[b]	55
1994/95	14%	7%	32%	17%	--	30%[c]	121
1995/96	2%	20%	49%	22%	--	--	41
1996/97	9%	43%	28%	9%	--	9%	53
1997/98	12%	27%	39%	7%	--	15%	107
1998/99	19%	32%	19%	14%	--	15%	78

[a]Includes 1 wolf (5%) harvested in August and 1 wolf (5%) harvested in October.

[b]Includes 3 wolves (6%) harvested in September.

[c]Includes 2 wolves (2%) harvested in August, 8 (7%) in September, 1 (1%) in October, 21 (17%) in November, and 4 (4%) harvested at unknown times.

Table 4 Unit 17 wolf harvest percent by transport method, 1991/92–1998/99

	Percent of harvest								
Regulatory year	Airplane	Dogsled Skis Snowshoes	Boat	3- or 4-Wheeler	Snow machine	ORV	Highway vehicle	Unk	N
1991/92	70%	--	--	--	30%	--	--	--	37
1992/93	5%	5%	--	--	84%	--	5%	--	19
1993/94	36%	2%	--	2%	58%	--	--	2%	55
1994/95	29%	10%	2%	--	60%	--	--	2%	121
1995/96	19%	5%	--	--	49%	--	--	--	41
1996/97	28%	--	--	--	72%	--	--	--	53
1997/98	18%	--	--	--	74%	--	--	8%	107
1998/99	12%	1	1	--	83%	--	--	3%	78

LOCATION

GAME MANAGEMENT UNIT: 18 (46,000 mi^2)

GEOGRAPHIC DESCRIPTION: Yukon–Kuskokwim Delta

BACKGROUND

Observations from trappers, fur buyers, and agency biologists indicate that wolf numbers have increased considerably in Unit 18, particularly along the main stem of the Yukon River and in the Kilbuck Mountains east of Bethel. The distribution and abundance of wolves in Unit 18 reflect the distribution and abundance of moose and caribou. The reported wolf harvest has increased considerably during this reporting period.

MANAGEMENT DIRECTION

MANAGEMENT GOALS AND OBJECTIVES

- Establish and maintain viable wolf populations in Unit 18.
- Monitor harvests through the sealing program, contacts with the public, and an annual trapper questionnaire.
- Explain regulations to local hunters and trappers and promote compliance with regulations.
- Monitor the size and population status of wolves and wolf packs in Unit 18.
- Minimize adverse interactions between wolves and the public.
- Develop updated population management objectives in consultation with the public and other agencies.

METHODS

No aerial surveys were planned or completed to determine the status of wolves in Unit 18. We observed wolves and wolf tracks during aerial surveys for other species. We discussed reports of wolf activity with other agency personnel, trappers, hunters, and local pilots. We held frequent discussions regarding wolf activity with the largest fur buyer in the area and with one particularly successful wolf trapper. A questionnaire that included questions regarding wolves was sent to area trappers.

We collected harvest information predominantly from sealing records. We continued to support license vendors and fur sealers in Unit 18. Public notices were sent to Unit 18 villages with information regarding fur-sealing requirements. Information and education media occasionally highlighted the topic of wolves.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

During the 1992–94 reporting period there were more reports of wolf activity than at any time since the 1930s. Trappers and hunters continued to report increasing numbers of wolves during the 1994–1996 reporting period. Unit 18 residents who ventured into adjacent Unit 19 also reported increasing wolf numbers.

The number of wolves in Unit 18 continued to increase through this reporting period. Within Unit 18, packs exist along the entire lower Yukon drainage, along the upper river portion of the main stem of the Kuskokwim, and throughout the mountain ranges east of Bethel. Overall, the estimated size of the Unit 18 wolf population increased during the reporting period. Beginning in 1996, the population ranged from 75–100 animals in 8–10 packs, and at the end of the reporting period we estimate there were 150–200 animals in 15–20 packs (Table 1).

Population Composition

We have no survey data or information to determine the composition of the wolf population in Unit 18.

Distribution and Movements

Observations reported by department staff and the public indicate several wolf packs occupy the entire length of the Yukon River in Unit 18. They also are throughout the Kilbuck Mountains and within the Kuskokwim River drainage near the Unit 19A boundary.

Resident packs are established along the Yukon River, where moose are available throughout the year. Along the main stem of the Kuskokwim River, resident packs are only in the most upriver portions of Unit 18 near the Unit 19 boundary.

In the Kilbuck Mountains, resident packs exist, but at lower densities than the resident packs along the Yukon River. However, this should not imply there are fewer wolves in the Kilbuck Mountains. With the seasonal influx of caribou from adjacent Units 17 and 19, we see an increase in wolf numbers. Wolves that arrive with the seasonal arrival of caribou probably do not stay in Unit 18 year round, but they are included in the population estimates because they contribute heavily to the harvest.

Wolves are occasionally encountered on the flats between the Kuskokwim River and the Kilbuck Mountains. They are nearly always associated with caribou and are probably as transient through the area as the caribou.

MORTALITY

Harvest

Seasons and Bag Limits

1996-1997 to 1998-1999 Units and Bag Limits	Resident Open Season (Subsistence and General Hunts)	Nonresident Open Season
Unit 18		
Residents and Nonresidents:		
Trapping - no limit	10 Nov–31 Mar	10 Nov–31 Mar
Hunting - 5 wolves	10 Aug–30 Apr	10 Aug–30 Apr

Board of Game Actions and Emergency Orders. There were no Board of Game actions regarding wolves for Unit 18 during this reporting period. However, there was legislative action to change the nonresident wolf tag fee from $175 to $30. This change first took effect for the 1998–1999 hunting season.

Hunter/Trapper Harvest. Sealing certificate data indicate the following wolf harvest for Unit 18: 29 during the 1996–1997 regulatory year, 43 in 1997–1998, and 45 in 1998–1999. The highest harvest during the decade preceding this reporting period was 17 in 1988–1989 and the average harvest was just under 6 from 1985–1986 through 1995–1996. Clearly, recent harvests have increased dramatically (Figure 1).

Most of the harvest occurred in the Kuskokwim drainage. In 1996–1997, 5 wolves were taken in the Yukon drainage, and 24 were taken in the Kuskokwim drainage. In 1997–1998, 6 wolves were taken in the Yukon drainage, and 37 were taken in the Kuskokwim drainage. In 1998–1999, 13 wolves were taken in the Yukon drainage and 32 were taken in the Kuskokwim drainage. This reflects the distribution of caribou abundant in the mountains east of the Kuskokwim during the years of this reporting period. It also reflects the distribution of caribou hunters who opportunistically take wolves. Of the wolves taken where the method of harvest is known, 10, 11, and 22 were shot rather than trapped in 1996–1997, 1997–1998, and 1998–1999, respectively (Table 2).

In 1996–1997, 9 males, 17 females, and 3 wolves of unknown sex were harvested. In 1997–1998, 29 males, 7 females, and 7 wolves of unknown sex were harvested. In 1998–1999, 24 males, 13 females, and 11 wolves of unknown sex were harvested. While it is not apparent that one sex is more vulnerable to harvest than the other on an annual basis, it is interesting to note that from 1985–1986 through 1998–1999, there were significantly more males (n = 94) taken than females (n = 53) in Unit 18 (Table 2).

Be aware that these data are derived from sealing certificates and consequently represent an absolute minimum estimate of wolf harvest. Many wolves caught in Unit 18 are neither sold nor sealed. Wolf ruffs are highly prized as parka trim, and the local domestic demand for wolf pelts is very high. Local residents generally prefer stiffer home-tanned wolf pelts for parka ruffs. We believe that most of the wolves harvested in Unit 18 are sealed, but a significant portion of the harvest remains unreported.

Permit Hunts. There were no permit hunts for wolves in Unit 18 during the reporting period.

Hunter/Trapper Residency and Success. Alaska residents harvested all of the wolves taken during this reporting period. Only one resident lived outside Unit 18. One trapper had unknown residency.

Harvest Chronology. The highest reported harvests have historically been in February; the second highest harvests have been in March (Table 3). During this reporting period there was a high harvest in January. This pattern is explained by the usual timing of snow accumulation and the improvement in travel conditions. Trapping is hampered by low snow, alternating freezing and thawing temperatures, and few hours of daylight. The intensity of caribou hunting and the subsequent incidental harvest of wolves are also dependent upon travel conditions. By January and through February, travel conditions usually improve.

Transport Methods. Snowmachines are used for transportation to harvest wolves. Only rarely are other methods used. In 1996–1997, a wolf was taken in September by a hunter using a boat. During March of the same season, a wolf was taken by a person using skis/snowshoes. Both of these wolves were probably taken incidental to other activities. In 1998–1999, 2 wolves were taken by a trapper using a dog team to run his trapline.

Other Mortality

No information is available on natural mortality of wolves in Unit 18.

HABITAT

Assessment

Extensive riparian, upland, and tundra habitats are available in Unit 18 to support much larger populations of moose, caribou, and muskoxen. Increased numbers of moose and caribou in the Yukon and Kuskokwim drainages have already resulted in an increase in the number of wolves in Unit 18. However, there are still large areas of vacant habitat suitable for moose, caribou, and muskoxen. As these habitats are utilized by ungulates, wolf populations will benefit.

Enhancement

There were no habitat enhancement activities for wolves in Unit 18 during the reporting period.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

There were no nonregulatory management problems or issues associated with wolves in Unit 18 that were identified during the reporting period.

CONCLUSIONS AND RECOMMENDATIONS

Wolf numbers have increased dramatically in Unit 18 in response to greater availability of ungulates. Moose along the Yukon River have increased in numbers and range to the point

that wolf packs are established from the Unit 18 boundary at Paimiut all the way to the Yukon River Delta. Wolves have also increased in the Kilbuck Mountains in response to a seasonal influx of caribou. Many of the wolves that use the eastern portion of Unit 18 leave the unit as caribou leave.

The current population estimate is 150–200 wolves in 15–20 packs for Unit 18. This estimate includes wolves that use adjacent game management units when caribou are not available in Unit 18.

Current management strategies in Unit 18 are designed to increase the numbers of caribou, moose, and muskoxen. An indirect result of increasing ungulate populations is increased availability of prey for wolves. Excessive human harvest is the principal factor limiting ungulate population growth in Unit 18. This is especially true for moose along the main stem of the Kuskokwim and muskoxen trying to colonize the mainland. For these ungulate populations to grow and become established, wolves may need to be harvested at sufficiently high levels to minimize predation on ungulates.

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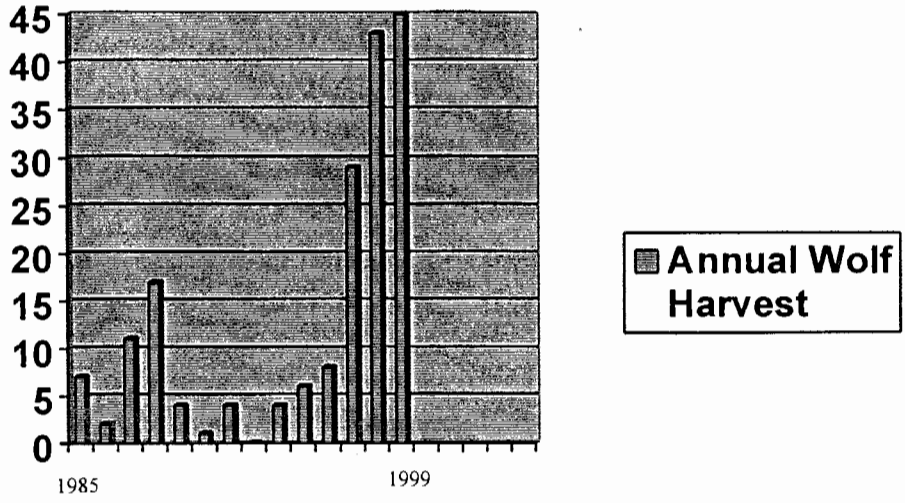

Figure 1 Annual Unit 18 wolf harvest 1985–1986 through 1998–1999

Table 1 Unit 18 fall wolf population estimates[a], 1985–1986 through 1998-1999

Regulatory year	Population estimate	Packs
1985–1986	25–50	5–7
1986–1987	25–50	5–7
1987–1988	25–50	5–7
1988–1989	50–75	6–7
1989–1990	50–75	6–7
1990–1991	75–100	6–7
1991–1992	75–100	6–7
1992–1993	75–100	6–7
1993–1994	75–100	6–7
1994–1995	75–100	6–7
1995–1996	75–100	8–10
1996–1997	75–100	10–15
1997–1998	100–150	12–18
1998–1999	150–200	15–20

[a]The basis for this estimate comes from incidental observations, reports from the public, sealing records, and trapper questionnaire results.

Table 2 Unit 18 wolf harvest, 1985–1986 through 1998–1999

Regulatory	Reported harvest			Method of take			Number successful
Year	M	F	Unknown	Trap/Snare	Shot	Unknown	trap/hunt
1985–1986	1		6	6	1		2
1986–1987	2				2		2
1987–1988	4	4	3	5	5	1	6
1988–1989	11	6					7
1989–1990	2	2					2
1990–1991	1			1			1
1991–1992	2	2		4			2
1992–1993	0	0		0			0
1993–1994			4				?
1994–1995	3		3	4	2		4
1995–1996	6	2		5	1	2	3
1996–1997	9	17	3	17	11	1	18
1997–1998	29	7	7	27	11	5	10
1998–1999	24	13	8	23	22		18

Table 3 Unit 18 wolf harvest chronology by time period, 1985–1986 through 1998–1999

	Harvest period						
Regulatory year	Nov	Dec	Jan	Feb	Mar	April	*N*
1985–1986	6	1					7
1986–1987		2					2
1987–1988		1	5	3	2		11
1988–1989		5	1	4	7		17
1989–1990			1	1	2		4
1990–1991				4			1
1991–1992					4		4
1992–1993							0
1993–1994			2		2		4
1994–1995		4		1	1		6
1995–1996	1			6	1		8
1996–1997	2	5	4	17			29[a]
1997–1998	3	1	12	20	2		43[b]
1998–1999	4	6	3	5	15	10	45[b]
Totals	16	25	28	61	36	10	181

[a]includes one wolf shot during the hunting season in September
[b]includes unknown month of harvest

LOCATION

GAME MANAGEMENT UNITS: 19A, B, C, and D and 21A and E (59,756 mi^2)

GEOGRAPHIC DESCRIPTION: Drainages of the Kuskokwim River upstream from the village of Lower Kalskag; Yukon River drainage from Paimiut upstream to, but not including, the Blackburn Creek drainage; the entire Innoko River drainage; and the Nowitna River drainage upstream from the confluence of the Little Mud and Nowitna rivers

BACKGROUND

Wolves play multiple roles in the economy and ecology of the upper Kuskokwim region. As furbearers, they provide pelts for personal use by subsistence-based residents and are harvested by trappers for commercial sale of their pelts. Hunters consider wolves to be a trophy big game animal, but also a competitor for moose.

Harvest of wolves in the upper Kuskokwim and middle Yukon drainages has been governed by regulations that have changed frequently in response to public controversies that arose primarily over wolf control programs in other regions of the state. Harvests dropped after the cessation of bounties in 1967. Also, the Federal Airborne Hunting Act of 1972 eliminated the common practice of shooting wolves from airplanes. However, the Department of Fish and Game continued to issue aerial shooting permits to members of the public until 1983 as part of specific management programs.

Few wolves were taken by aerial shooting in Unit 19, with the exception of the 1978–1979 season when 29 were reported killed using this method. Only 4 wolves, other than those taken in 1978–1979, were taken under the authority of aerial permits during 1972–1983. Most harvest (67%) during that period occurred by land-and-shoot hunting, and the kill was 32–81 annually (Pegau 1984). Hunting of wolves by land-and-shoot continued until the 1992–1993 season when all same-day-airborne hunting was prohibited. Beginning in the 1994–1995 season, same-day-airborne taking of wolves was permitted for holders of a trapping license if trappers moved more than 300 ft from the aircraft before shooting a wolf. A public ballot initiative that passed in November 1996 repealed that "land and walk" regulation, again prohibiting all same-day-airborne hunting of wolves beginning in late February 1997.

Wolf predation plays a significant role in the population dynamics of moose, the primary ungulate species sought by subsistence hunters throughout the upper Kuskokwim drainage. As early as 1980 biologists recognized moose densities were low in the upper Kuskokwim. At the time, the situation was characterized as a "predator problem." The problem was aggravated during 1989–1995 by 4 "severe" winters with deep, persistent snow. In the early 1990s residents reported declining moose numbers; and in 1994, with the aid of the Tanana Chiefs Conference, local residents met with officials from the Alaska Department of Fish and Game

to discuss predator control options. Local residents favored wolf control programs designed to reduce wolf numbers and increase moose for subsistence use. The Board of Game adopted a wolf control program for Unit 19D East in 1995 and reauthorized the same plan with updated population numbers in January 2000. However, no plan has been implemented.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

Wolf populations will be managed to provide for human uses and to ensure that wolves remain an integral part of Interior Alaska's ecosystems. Compatible human uses include hunting and trapping (both for personal use and commercial sale of furs), photography, viewing, listening, and scientific and educational purposes. The aesthetic value of being aware of or observing wolves in natural interactions with their environment is also recognized as an important human use of wolves. The domestication of wolves for personal use or for commercial purposes is generally considered incompatible with department management policies.

Management may include manipulation of wolf population size by humans and total protection of wolves from human influence. Not all human uses will be allowed in all areas or at all times. Management will focus on providing sustained, diverse human uses of wolf populations consistent with goals listed in the Wolf Conservation and Management Policy for Alaska, adopted by the Alaska Board of Game on 30 October 1991 and revised on 29 June 1993. Those goals are to:

- Ensure the long-term conservation of wolves throughout their historic range in Alaska in relation to their prey and habitat.
- Provide for the broadest possible range of human uses and values of wolves and their prey populations that meet wildlife conservation principles and which reflect the public's interest.
- Increase public awareness and understanding of the uses, conservation, and management of wolves, their prey, and habitat in Alaska.

MANAGEMENT OBJECTIVES

- Conduct wolf predation control programs as directed by the commissioner and Board of Game.
- Provide for a sustained annual harvest rate of up to 30% from the combined wolf population of Units 19, 21A, and 21E, except where greater harvest rates are mandated by approved wolf predation control implementation plans.
- Provide trapper education programs to increase trapper skills, ethics, and regulatory compliance.

- Conduct an aerial survey of the wolf population in Unit 19D East during late winter 1999.
- Cooperate with any ongoing wolf studies conducted by the US Fish and Wildlife Service.
- Continue to refine annual wolf population estimates in the area, based on incidental sightings, hunter interviews, trapper questionnaires, and evaluation of sealing documents.
- Monitor harvests through sealing records and trapper questionnaires.
- By March 1998 develop a proposal to conduct research on low-density wolf-prey population dynamics in Unit 19D East.
- Model the potential effects of wolf predation on prey populations in all subunits.

METHODS

We completed population surveys using a Sample Unit Probability Estimator (SUPE) method (Becker et al. 1998) during spring 1995 and spring 1997 in a 5200-mi^2 segment of Unit 19D East. Unit 19D East includes that portion of Unit 19 within the Kuskokwim River drainage upstream from the Salatna River, not including the Takotna River drainage upstream from its confluence with the Nixon Fork River. We obtained additional information about wolf pack sizes and territory boundaries from conversations with wolf hunters and trappers.

We estimated wolf population size using a combination of information from Unit 19D East surveys, harvest records, and hunter/trapper interviews and questionnaires. Estimates were summarized by regulatory year (RY = 1 Jul through 30 Jun, e.g., RY99 = 1 Jul 1999 through 30 Jun 2000).

We gathered harvest statistics largely from sealing documents, although we also used Fur Acquisition Reports and Fur Export Reports. I assumed that >90% of the annual wolf harvest was reflected on sealing documents because most of the wolves harvested from western Interior Alaska are sold (versus used domestically for garments). During the sealing process, information was collected on specific location and method of take, date, sex, color of pelt, estimated size of the wolf pack, and transportation. Harvest data were summarized by regulatory year.

RESULTS AND DISCUSSION

POPULATION STATUS AND TREND

Population Size

We estimated fall wolf population in all subunits at 1200–1300, 1300–1500 and 1400–1600 during RY96, RY97, and RY98, respectively (Table 1). Trapper questionnaires indicated wolves were moderate to abundant during RY96–RY99, with a stable to increasing population trend.

We estimated a wolf density of 24.6–41.2 wolves/mi^2 (9.5–15.9 wolves/1000 km^2) (90% CI) in Unit 19D East during spring 1995 using the SUPE method over 5200 mi^2. Using the same method over the same area, we estimated 7.8–14.0 wolves/mi^2 (3.0–5.4 wolves/1000 km^2) during spring 1997. This indicated a 67% decline in the wolf population within 2 years. This was consistent with a prediction drawn from the prey biomass versus wolf density relationships seen in other parts of Alaska and North America (Fuller 1989) (i.e., 6.7–11.4 wolves/mi^2 or 2.6–4.4 wolves/1000 km^2).

Wolf population declines demonstrated in Unit 19D East were apparently limited to that subunit. Populations elsewhere in the management area remained stable or increased during recent years based on analyses of trapper questionnaires, sealing certificates, and incidental observations. However, no other population estimation surveys have been completed.

Population Composition

No data were available concerning the sex composition of the wolf population except sex ratios reported on sealing documents from the harvested segment of the population. Those sex ratios in the harvest were not significantly different from 1:1 during RY94–RY95, and we suspect the population at large also contained nearly equal sex ratios.

Distribution and Movements

Wolves are present throughout all subunits. The harvest was well distributed, as were wolf tracks and incidental sightings. Good habitat and potential ungulate prey exist throughout the management area.

MORTALITY

Harvest

Season and Bag Limit.

Unit/Bag Limit/Special Restrictions	Resident/Nonresident Open Seasons
RY96	
Units 19, 21A, and 21E.	
HUNTING: 5 wolves. No hunting wolves same day as airborne.	10 Aug–30 Apr
TRAPPING: No limit. Must be greater than 300 ft from aircraft on same day as airborne, until 7 March 1997 (then same-day-airborne was prohibited)	1 Nov–30 Apr
RY97	
Units 19, 21A, and 21E.	
HUNTING: 5 wolves. No hunting wolves same day as airborne.	10 Aug–30 Apr

Unit/Bag Limit/Special Restrictions	Resident/Nonresident Open Seasons
TRAPPING: No limit. No hunting wolves same day as airborne.	1 Nov–30 Apr
RY98	
Units 19, 21A, and 21E.	
HUNTING: 5 wolves. No hunting wolves same day as airborne.	10 Aug–30 Apr
TRAPPING: No limit. No hunting wolves same day as airborne.	1 Nov–30 Apr
RY99	
Units 19, 21A, and 21E.	
HUNTING: 5 wolves. No hunting wolves same day as airborne.	10 Aug–30 Apr
TRAPPING: No limit. No hunting wolves same day as airborne.	1 Nov–30 Apr

Board of Game Actions, Emergency Orders, and Legislative Actions. During the January 1998 Board of Game Meeting, the board authorized a reduction in the price of nonresident wolf tags from $175 to $30, and an elimination of the nonresident tag fee in units where Wolf Control Implementation Plans have been approved. Therefore, the fee required for nonresident wolf hunting was eliminated in all of Unit 19.

The Board of Game authorized a Wolf Control Implementation Plan in 1995 and reauthorized an updated version of the same plan in January 2000. Updates to the plan included revisions to the population estimates and the corresponding population goals. The major population changes since the first plan were a decrease in the moose density and a decrease in wolf population size. Neither plan has been implemented. During January 2000, the board also authorized the use of snowmobiles to pursue wolves in areas with current Wolf Control Implementation Areas.

During March 2000 the board increased the wolf hunting bag limit in Unit 19D from 5 during the season to 10 wolves per day with no season limit. The start of the trapping season was also changed to 1 October from 1 November, with the "snare only of 3/32" or larger" stipulation already in regulation for April and October wolf trapping seasons.

Hunter/Trapper Harvest. In all subunits, 177 wolves were reported taken during RY96, a harvest rate of approximately 14% (Tables 2, 3, and 4). The reported harvest during RY97 was 96 (6.7 % harvest rate). During RY98, 153 wolves (10% harvest rate) were reported taken. The average harvest for RY94–RY98 was 107, which is slightly up from RY89–RY93 average of 97. Overall, wolf harvests increased. This was expected because trappers increased their efficiency by adapting to changing regulations governing trapping methods and because they took advantage of wolf trapping education programs (Whitman 1997).

Hunter Residency and Success. Local trappers and hunters took most of the annual wolf harvest. Hunters/trappers using airplanes for access typically traveled from the south side of the Alaska Range to take wolves in Units 19 and 21 in past years, but because of the aircraft-use restrictions in effect, this transportation mode and method of hunting has decreased. The proportion of the annual wolf harvest taken by local hunters and trappers increased. Nonresidents take most of the wolves during the autumn months incidental to hunting other big game species.

Success rates by wolf hunters/trappers are difficult to determine. One indicator may be the mean number of wolves taken per successful hunter/trapper (Table 2). This number varies annually and shows no clear trend.

Harvest Chronology. Most reported wolf harvest occurred during February and March (Table 3). March continued to have the highest wolf harvests, probably due to access and weather constraints during other times of the year. Increased day length in March, coupled with adequate snow cover to allow tracking wolf packs and subsequent landing of aircraft or overland transport by snowmachine combine to facilitate the greater harvests during that month. However, with current restrictions on the use of aircraft, we anticipate future harvests will become more equally distributed throughout the winter.

Hunters, during the fall, are taking greater numbers of wolves than previously observed. During RY94–RY98, hunters took an average of 16.8 wolves during August and September, while during RY89–RY93 hunters took an average 6 wolves during the same time period (Table 3). This increase can probably be attributed to several factors including increased populations, increased hunter awareness of the effects of wolf predation, reduction or elimination of tag fees (1998), and increased interest in wolf harvest by guided hunters.

Transport and Harvest Methods. As Whitman (1997) predicted, the method of transportation used by trappers to harvest wolves has shifted from primarily aircraft during RY89–RY91 to snowmachines during RY92–RY98, with the exception of RY95 when trappers using aircraft took more wolves than trappers using snowmobiles (Table 5). Despite the shift in transport methods, aircraft remain an important method of transport for many wolf trappers. Other methods of transport, such as dog team and snowshoes, were less important.

Other Mortality

Natural mortality of nondispersing wolves is relatively low. During RY99, a trapper noted one a case of a wolf being crippled by a blow to the spine. The wolf was found paralyzed from the hips back; and, after skinning, a large contusion was noted just anterior of the pelvis. Injuries and mortality inflicted during predatory attempts on moose are probably the largest component of natural mortality. Cases of nonspecific mortality have also been noted, but the amount of information on this type of mortality is small.

NONREGULATORY MANAGEMENT PROBLEMS/NEEDS

A major challenge faced by managers is collecting survey and inventory information on wolf populations. Aerial surveys to estimate population size require proper climatic conditions, a high level of tracking ability by pilot/observer teams, and adequate funding.

CONCLUSIONS AND RECOMMENDATIONS

Wolf harvests have remained stable in the absence of same-day-airborne taking of wolves. This occurred because of increased trapper education on effective methods of trapping wolves. However, the proportion of the estimated wolf population being harvested has declined. Trapping is not regulating the wolf population. Some trapper incentive programs will undoubtedly increase harvest in small areas, but will not reduce overall wolf numbers. Recent regulatory changes by the Board of Game will likely have little effect on the overall harvest of wolves.

Objectives will be modified for the next reporting period to reflect increased efforts in public education and to reflect the Board of Game's adoption of a wolf predation control implementation plan that may remain in effect for up to 5 years beginning 1 July 2000.

Our objective will be to provide for a sustained annual harvest rate of up to 30% from the combined wolf population of Units 19, 21A, and 21E, except where greater harvest rates are mandated by approved wolf predation control implementation plans.

Recommended activities to achieve our objective are to:

- Conduct wolf predation control programs as directed by the commissioner and Board of Game.
- Provide trapper education programs to increase trapper skills, ethics, and regulatory compliance.
- Conduct an aerial survey of the wolf population in Unit 19D East during late winter 2001.
- Cooperate with any other agencies conducting wolf studies within the area.
- Continue to refine annual wolf population estimates in the area, based on incidental sightings, hunter interviews, trapper questionnaires, and evaluation of sealing documents.
- Monitor harvests through sealing records and trapper questionnaires.

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Table 1 Units 19, 21A, and 21E autumn wolf population estimates[a], regulatory years 1985–1986 through 1998–1999

Regulatory year	Population estimate	Number of packs	$\bar{x}$ Wolves/Pack
1985–1986	660–780	110–129	6.0
1986–1987	670–780	107–136	6.0
1987–1988	665–770	76–95	8.4
1988–1989	710–815	72–88	9.5
1989–1990	720–940	72–91	10.2
1990–1991	720–940	72–91	10.2
1991–1992	720–940	72–91	10.2
1992–1993	750–950	71–92	10.4
1993–1994	970–1000	72–90	12.2
1994–1995	1568–1768	170–200	9.0
1995–1996	1200–1768	170–200	8.0
1996–1997	1200–1300	150–170	7.8
1997–1998	1300–1500	160–180	8.2
1998–1999	1400–1600	170–190	8.3

[a] Fall estimate = pretrapping season population based on population surveys, incidental observations, reports from public, sealing records, and trapper questionnaires.

Table 2 Units 19, 21A, and 21E wolf harvest, regulatory years 1985–1986 through 1998–1999

Regulatory year	Reported harvest				Method of take			$\bar{x}$ Wolves/ Trapper
	M	F	Unk	Total	Trap	Shot	Unk	
1985–1986	26	29	0	55	24	31	0	2.2
1986–1987	50	38	4	92	24	68	0	4.2
1987–1988	114	97	9	220	29	189	2	3.8
1988–1989	89	68	21	178	12	165	1	3.6
1989–1990	105	86	12	203	27	161	5	3.4
1990–1991	102	87	6	195	12	183	0	3.1
1991–1992	57	62	15	134	25	109	0	2.4
1992–1993	22	13	15	50	24	24	2	1.9
1993–1994	48	45	5	98	42	51	5	2.2
1994–1995	124	92	22	238	93	142	3	2.7
1995–1996	75	45	1	121	43	77	1	2.9
1996–1997	73	76	3	152	84	56	12	2.7
1997–1998	49	41	6	96	61	33	2	2.0
1998–1999	84	62	7	153	82	71	0	2.1
% of Total	51%	42%	7%	100%	30%	69%	1%	100%

Table 3 Units 19, 21A, and 21E wolf harvest chronology, regulatory years 1985–1986 through 1998–1999

Regulatory year	Harvest period										Total harvest
	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Unk	
1985–1986	0	2	0	2	11	14	21	5	0	0	55
1986–1987	0	1	0	8	5	5	38	34	1	0	92
1987–1988	1	5	0	5	9	37	53	87	18	5	220
1988–1989	2	3	1	4	7	15	14	118	2	12	178
1989–1990	1	8	0	7	21	30	25	108	3	0	203
1990–1991	0	5	1	1	9	21	43	116	0	0	195
1991–1992	0	2	0	1	19	19	35	57	1	1	134
1992–1993	1	5	0	4	1	3	12	21	3	0	50
1993–1994	2	7	0	4	10	21	13	35	3	3	98
1994–1995	4	12	2	4	31	42	60	67	16	0	238
1995–1996	0	1	1	6	2	17	31	54	9	0	121
1996–1997	1	16	0	15	27	27	28	36	1	1	152
1997–1998	4	21	0	8	15	6	22	18	2	0	96
1998–1999	3	24	3	2	14	26	26	51	3	1	153
% of Total:	1%	5%	<1%	4%	12%	14%	20%	40%	3%	1%	100%

Table 4 Units 19, 21A, and 21E wolf harvest by subunit, regulatory years 1985–1986 through 1998–1999

Regulatory	Unit 19						Unit 21			
year	A	B	C	D	Z	Subtotal	A	E	Subtotal	Total
1985–1986	2	2	5	31	0	40	12	3	15	55
1986–1987	8	16	22	29	0	75	17	0	17	92
1987–1988	55	56	13	15	3	142	45	33	78	220
1988–1989	6	32	40	32	0	110	44	24	68	178
1989–1990	26	46	41	21	0	134	64	5	69	203
1990–1991	41	11	44	32	0	128	42	25	67	195
1991–1992	20	22	49	20	1	112	7	15	22	134
1992–1993	14	5	11	3	2	35	9	6	15	50
1993–1994	6	19	37	22	0	84	7	7	14	98
1994–1995	45	42	61	38	0	171	9	43	52	238
1995–1996	19	27	19	18	0	83	4	34	38	121
1996–1997	12	18	32	18	8	88	34	30	64	152
1997–1998	14	14	7	24	3	62	24	10	34	96
1998–1999	42	38	13	19	0	112	18	23	41	153
5-yr $\bar{x}$	26	28	25	27	2	107	19	25	44	151

Table 5 Units 19, 21A, and 21E harvest by transport method, regulatory years 1989–1990 through 1998–1999

Regulatory year	Transport method				Total
	Aircraft	Snowmobile	Dog Team/snowshoe	Other	
1989–1990	161	35	1	6	203
1990–1991	162	24	1	8	195
1991–1992	109	2	14	9	134
1992–1993	9	29	1	11	50
1993–1994	49	36	1	12	98
1994–1995	64	115	2	57	238
1995–1996	85	26	0	10	121
1996–1997	40	68	11	33	152
1997–1998	28	41	8	19	96
1998–1999	42	98	0	13	153

LOCATION

GAME MANAGEMENT UNITS: 20A, 20B, 20C, 20F, and 25C (39,228 mi^2)

GEOGRAPHIC DESCRIPTION: Lower Tanana Valley, Central Yukon Valley

BACKGROUND

Wolf population size and harvest vary substantially both spatially and temporally within this management area. Fluctuations in wolf numbers primarily result from variation in prey availability and wolf control programs; whereas, fluctuations in harvest result from variation in wolf numbers and access.

Human consumptive use of caribou, moose, and sheep dominates interest in wildlife within these subunits, partly because of their proximity to Fairbanks, the second largest concentration of people in the state. During the last 25 years, Alaska Department of Fish and Game (ADF&G) conducted wolf predation control programs in Units 20A (autumn 1975–spring 1982 and Oct 1993–Nov 1994) and 20B (autumn 1979–spring 1986) to increase moose and caribou populations. The most recent program (in Unit 20A) followed a density-dependent caribou population decline (10,700 to 3600) that was exacerbated by unfavorable weather and predation.

Because of the interest in consumptive use, ADF&G staff continue intensive investigations on predator–prey relationships, especially in Unit 20A (Gasaway et al. 1983; Boertje et al. 1996) In addition, within Denali National Park and Preserve (DNP&P) in adjacent Unit 20C, a 14-year wolf study continues because of interest in the animal as predator, wilderness symbol, and fundamental component of a naturally regulated system (Adams et al. 1995; Mech et al. 1995; Meier et al. 1995).

Besides the attention the wolf receives as a predator and wilderness symbol, trappers continue the long tradition of harvesting this economically and culturally significant furbearer.

MANAGEMENT DIRECTION

MANAGEMENT GOALS

ADF&G will manage wolf populations to provide for human uses and to ensure that wolves remain an integral part of Interior Alaska's ecosystems. Compatible human uses include hunting and trapping (both for personal use and commercial sale of furs), photography, viewing, listening, and scientific and educational purposes. We recognize the aesthetic value of observing wolves in their natural environment as an important human use of wolves.

We also recognize that integral to wolf management is the premise that wolf populations are renewable resources that can be harvested and manipulated to enhance human uses of other resources. Management may include both the manipulation of wolf population size and total protection of wolves from human influence.

Management Objectives

Objectives during this reporting period were to:

- Monitor harvest through sealing certificates.
- Conduct aerial surveys in Units 20B, 20C, 20F, and 25C.
- Monitor the wolf population in Unit 20A by maintaining radio collars in wolf packs, including packs inhabiting the flats.
- Assist wolf research efforts in Unit 20A.

METHODS

Population Size

During this reporting period we conducted intensive wolf population surveys in Unit 20A. We conducted aerial surveys in Unit 20A throughout winters 1996–1997 through 1998–1999. More specifically, we estimated wolf numbers from radiocollared packs in the foothills and extrapolated to the Tanana Flats to obtain overall Unit 20A annual population estimates. This work was conducted as part of ongoing wolf research in the unit (McNay 1999).

We collected miscellaneous observations and reports for all areas. We also collected additional information for Unit 20B while conducting lynx/hare surveys, moose surveys, and other reconnaissance flights. However, extrapolations from earlier or adjacent surveys provide the primary basis for estimates in areas other than Unit 20A. We used data from radiotelemetry surveys in Denali National Park to estimate wolf numbers in Unit 20C.

Harvest

We used wolf sealing certificate data to determine annual harvests. During the sealing process, information was collected on specific location and method of take, date, sex, color of pelt, estimated size of the wolf pack, and transportation. Harvest data were summarized by regulatory year (RY = 1 Jul through 30 Jun, e.g., RY99 = 1 Jul 1999 through 30 Jun 2000).

RESULTS AND DISCUSSION

Population Status and Trend

Population Size

In early winter 1996 we estimated 650–900 wolves in 85–130 packs for all subunits. In early winter 1997, we estimated 675–925 wolves in 85–130 packs. In early winter 1998, we estimated 700–950 wolves in 85–130 packs. While these totals vary, they only reflect new information for Units 20A and 20C (Table 1). The ranges represent the combined subjective minimum and maximum estimates for each subunit.

Wolf population trends in Units 20A and 20C differed substantially during the reporting period. Wolf numbers in Unit 20A increased after wolf control was suspended in 1994 and approached precontrol levels by 1998 (Table 1). By contrast, researchers in Denali National Park and Preserve documented a sharp decline in the wolf population in southern Unit 20C in 1994. The wolf population then stabilized at that lower level during 1994–1998. Lower estimates reflect those observations.

MORTALITY

Harvest

Season and Bag Limit. Smith (1994) summarized the history of regulations pertaining to same-day-airborne and land-and-shoot taking of wolves in Alaska. The hunting and trapping regulations for Units 20 and 25C during this reporting period were:

Units and Bag Limits	Resident/Subsistence Open Seasons	Nonresident Open Seasons
Units 20A, 20B, 20C, 20F, and 25C		
RY96		
HUNTING: 5 wolves. No wolf hunting same day airborne.	10 Aug–30 Apr	10 Aug–30 Apr
TRAPPING: No limit. A wolf may be shot same day airborne if caught in a trap or snare, or trapper is more than 300 ft from airplane.	1 Nov–30 Apr	1 Nov–30 Apr
RY97–RY99		
HUNTING: 5 wolves. No wolf hunting same day airborne.	10 Aug–30 Apr	10 Aug–30 Apr
TRAPPING: No limit. A wolf may be shot same day airborne if caught in a trap or snare.	1 Nov–30 Apr	1 Nov–30 Apr

Board of Game Actions and Emergency Orders. In June 1993 the Board of Game authorized same-day-airborne shooting of wolves, provided the person attempting to take a wolf had a trapping license and was at least 300 ft from the airplane. During November 1996, this method of take was prohibited through a statewide ballot referendum (effective 25 February 1997).

Hunter/Trapper Harvest. Wolf harvest in all subunits during RY96–RY98 was similar (annual mean = 165 wolves) to that reported for RY91–RY95 (annual mean = 154 wolves). This generally was the case for all subunits except Unit 25C, where the mean annual harvest was 8 wolves during RY96–RY98, but was 15 wolves during RY91–RY95.

Wolf harvest varied considerably among years. Excluding years in which wolf control was conducted (i.e., 1993 and 1994), area-wide wolf harvest increased in RY96 (209) to its highest level since at least RY85, fell in RY97 (113) to its lowest level since RY89, and then increased again to a near record high in RY98 (173). This general pattern was apparent in all subunits. Evidence suggests that these oscillations were not likely related to fluctuations in wolf numbers, but rather to other unidentified factors (e.g., weather, snow conditions, trapping pressure). In Unit 20A the percentage of the estimated fall wolf population harvested by hunters and trappers fell from 33% in RY95 and RY96 to 20% in RY97 (ME McNay, ADF&G, unpublished data), despite an apparent increase in the wolf population (Tables 1 and 2).

Harvest Chronology. Midwinter trapping continued to provide most of the harvest (Table 3). April accounted for 1.6% (8 of 495) of the wolves taken by the public during RY96–RY98.

Method of Take and Transport Methods. Trapping and snaring continued as the leading methods of take (Table 2). Airplanes and snowmachines continued to be the most popular types of transportation (Table 4).

CONCLUSIONS AND RECOMMENDATIONS

Management objectives during this reporting period were not quantitative, and therefore, can only be subjectively evaluated. We made progress on all of them, except conducting aerial surveys in Units 20B, 20C, 20F, and 25C. We monitored harvest, conducted aerial surveys in Unit 20A, monitored the Unit 20A population using radiotelemetry, and assisted wolf research efforts in Unit 20A. During the next reporting period, new objectives will be formulated that are quantitative.

Wolf research in Unit 20A should be recognized as important to intensive management statewide. We do not know whether the wolf population will reach the theoretical density that the number of prey can support. If the wolf population does reach its potential, the current success in moose management will be short-lived. To date, we have not reaped the harvest benefits of the moose population growth because the public desires higher moose densities, or fears that predation and cow harvests will cause a moose population decline. Those concerns are understandable given the history of the effects of predation and cow harvests in Unit 20A during the 1970s (Gasaway et al. 1983). To gain public support for more aggressive harvest of enhanced moose populations, we need a clear strategy for management of enhanced predator–prey systems. Forming a viable management strategy hinges on a thorough understanding of wolf predation, weather, and competition for food among moose.

If the wolf population does not reach its potential, we can continue to recommend increased ungulate harvests. However, in that scenario we still need to determine what factors regulate the wolf population in order to maintain that regulation. In RY98 hunters and trappers harvested an estimated 30% of the autumn 1998 wolf population in Unit 20A. So, harvest could potentially regulate the wolf population at a level that allows high moose harvests. Alternatively, social or complex food-related factors may result in regulation of the wolf population. The theoretical wolf densities expected from the current prey biomass have not

been observed in the Interior. Further, wolf harvest intensity may influence the operation of such density-dependent factors. Similar questions apply to wolf–caribou relationships (Dale 1997).

In the near term, I recommend maintaining current Unit 20A seasons and bag limits to evaluate harvest trends under current regulations and trapping effort. Similarly, there seems little need to recommend changes for other units. However, we receive numerous comments regarding the April trapping/hunting season. Concerns over fur quality and the pregnancy status of adult females will probably continue to generate proposals. Because trappers take so few wolves in April, little biological rationale exists for or against April seasons.

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Table 1 Units 20A, 20B, 20C, 20F, and 25C fall wolf population estimates, 1985–1998

Unit	Year	Population estimate[a]	Number of packs	Basis of estimate
20A	1985	195	26	Aerial survey, trapper interviews
	1986	220–240	25–30	Extrapolation from previous year
	1987	200–230	25–30	Extrapolation from previous year
	1988	183	21	Aerial survey, trapper reports, radiocollars
	1989	180–220	20–25	Extrapolation from previous year
	1990			
	1991	267	24–34	Aerial survey, trapper reports
	1992	220–295	25–35	Extrapolation from previous year
	1993	281	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
	1994	193	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
	1995	198	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
	1996	207	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
	1997	227	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
	1998	268	20–25	Radiotelemetry and aerial surveys (mountains), extrapolation (Tanana Flats)[b]
20B	1985	168	25	Aerial survey, radiocollars
	1986	140–180	21–27	Extrapolation from previous year
	1987	140–180	21–27	Extrapolation from previous year
	1988	140–180	21–27	Extrapolation from previous year
	1989	150–225	20–25	Extrapolation from previous year
	1990	222		Aerial survey of 20B West, extrapolation
	1991			
	1992	150–225	20–30	Extrapolation
	1993	150–225	20–30	1992 extrapolation
	1994	150–225	20–30	1992 extrapolation
	1995	150–225	20–30	1992 extrapolation
	1996	150–225	20–30	1992 extrapolation
	1997	150–225	20–30	1992 extrapolation
	1998	150–225	20–30	1992 extrapolation

Table 1 Continued

Unit	Year	Population estimate[a]	Number of packs	Basis of estimate
20C	1985	120–140	20–25	Density extrapolation from 20B
	1986	120–140	20–25	National Park Service study and extrapolation
	1987	100–120	20–25	National Park Service study and extrapolation
	1988	180–220	20–25	National Park Service study and extrapolation
	1989	175–225	20–25	National Park Service study and extrapolation
	1990	320		
	1991			
	1992	200–320	25–40	National Park Service study and extrapolation
	1993	200–320	25–40	Denali National Park data and extrapolation
	1994	150–200	25–40	Denali National Park data and extrapolation
	1995	150–200	25–35	Denali National Park data and extrapolation
	1996	150–200	25–35	Denali National Park data and extrapolation
	1997	150–200	25–35	Denali National Park data and extrapolation
	1998	150–200	25–35	Denali National Park data and extrapolation
20F	1985	60–100	10–15	Density extrapolation from 20B
	1986	60–100	10–15	Density extrapolation from 20B
	1987	60–100	10–15	Density extrapolation from 20B
	1988	80–120	15–30	Density extrapolation from 20C
	1989	75–110	15–30	Density extrapolation from 20C
	1990	130		Density extrapolation from 20B
	1991			
	1992	75–125	10–20	
	1993	75–125	10–20	1992 extrapolation
	1994	75–125	10–20	1992 extrapolation
	1995	75–125	10–20	1992 extrapolation
	1996	75–125	10–20	1992 extrapolation
	1997	75–125	10–20	1992 extrapolation
	1998	75–125	10–20	1992 extrapolation
25C	1985			

Table 1 Continued

Unit	Year	Population estimate[a]	Number of packs	Basis of estimate
	1986	50–60	8–10	Density extrapolation from 20B
	1987	50–60	8–10	Density extrapolation from 20C
	1988	60–100	15–30	Density extrapolation from 20C
	1989	75–110	15–30	Density extrapolation from 20C
	1990	107		Density extrapolation from Unit 20B
	1991			
	1992	75–125	10–20	Density extrapolation
	1993	75–125	10–20	1992 extrapolation
	1994	75–125	10–20	1992 extrapolation
	1995	75–125	10–20	1992 extrapolation
	1996	75–125	10–20	1992 extrapolation
	1997	75–125	10–20	1992 extrapolation
	1998	75–125	10–20	1992 extrapolation

[a] Includes an additional 10% to account for wolves not in packs.

[b] M McNay, Alaska Department of Fish and Game, unpublished data.

Table 2 Units 20A, 20B, 20C, 20F, and 25C wolf harvest, regulatory years 1985–1986 through 1998–1999

Unit	Regulatory year	Reported harvest				Method of take			
		M	F	Unk	Total	Trap/ Snare	Shot	Unk/ Other	Wolf control
20A	1985–1986				24	17	7	0	0
	1986–1987				37	33	3	1	0
	1987–1988	19	13	4	36	30	5	1	0
	1988–1989	17	11	4	32	23	9	0	0
	1989–1990	20	10	1	31	21	9	1	0
	1990–1991	31	20	5	56[a]	10	44	2	0
	1991–1992	35	28	4	67	43	24	0	0
	1992–1993	30	25	2	57	49	6	2	0
	1993–1994	66	83	11	160[b]	47	11	4	98
	1994–1995	34	29	3	66[b]	25	4	1	36
	1995–1996	37	21	1	59	52	5	2	0
	1996–1997	36	26	0	62	49	11	2	0
	1997–1998	20	19	2	41	29	11	1	0
	1998–1999	29	37	10	76	67	9	0	0
20B	1985–1986				57	20	5	0	32
	1986–1987				6	5	1	0	0
	1987–1988	8	10	0	18	17	1	0	0
	1988–1989	20	13	1	34	31	3	0	0
	1989–1990	18	16	1	35	28	6	1	0
	1990–1991	5	6	0	11	8	3	0	0
	1991–1992	25	23	8	56	41	13	2	0
	1992–1993	27	17	3	47	38	9	0	0
	1993–1994	48	53	2	103	90	7	2	0
	1994–1995	27	21	2	50	33	17	0	0
	1995–1996	19	25	1	45	36	9	0	0
	1996–1997	41	40	2	83	74	9	0	0
	1997–1998	29	19	1	49	40	8	1	0
	1998–1999	30	29	4	63	53	10	0	0
20C	1985–1986				8	6	0	0	0
	1986–1987				4	1	2	0	0
	1987–1988	7	5	1	13	8	3	2	0
	1988–1989	5	4	0	9	8	1	0	0
	1989–1990	8	8	1	17	11	5	1	0
	1990–1991	21	22	3	46	18	25	3	0
	1991–1992	16	5	0	21	13	8	0	0
	1992–1993	11	5	1	17	12	4	1[a]	0
	1993–1994	13	14	2	29	33	3	0	0
	1994–1995	8	3	0	11	10	2	0	0

Table 2 Continued

Unit	Regulatory year	Reported harvest				Method of take			
		M	F	Unk	Total	Trap/ Snare	Shot	Unk/ Other	Wolf control
	1995–1996	4	3	1	8	7	1	0	0
	1996–1997	15	21	1	37	25	8	4	0
	1997–1998	5	5	0	10	8	1	1	0
	1998–1999	15	6	6	27	26	1	0	0
20F	1985–1986				2	2	0	0	0
	1986–1987				2	2	0	0	0
	1987–1988	1	1	3	5	1	4	0	0
	1988–1989	2	3	0	5	5	0	0	0
	1989–1990	10	2	2	14	11	2	1	0
	1990–1991	2	5	0	7	6	0	1	0
	1991–1992	4	6	0	10	7	2	1	0
	1992–1993	0	2	0	2	1	1	0	0
	1993–1994	7	3	0	10	11	3	0	0
	1994–1995	2	5	0	7	2	5	0	0
	1995–1996	0	1	0	1	0	1	0	0
	1996–1997	2	5	3	10	7	3	0	0
	1997–1998	5	6	0	11	7	4	0	0
	1998–1999	2	0	0	2	2	0	0	0
25C	1985–1986				2	2	0	0	0
	1986–1987				2	0	1	1	0
	1987–1988	5	5	0	10	10	0	0	0
	1988–1989	2	1	0	3	0	3	0	0
	1989–1990	3	4	0	7	0	7	0	0
	1990–1991	8	4	0	12	1	10	1	0
	1991–1992	2	5	0	7	3	4	0	0
	1992–1993	18	9	1	28	27	1	0	0
	1993–1994	10	9	0	19	16	3	0	0
	1994–1995	10	3		13	10	3	0	0
	1995–1996	7	2	1	10	8	1	1	0
	1996–1997	10	5	2	17	15	2	0	0
	1997–1998	0	1	1	2	2	0	0	0
	1998–1999	2	1	2	5	4	1	0	0
Combined	1985–1986				93				
	1986–1987				51				
	1987–1988				82				
	1988–1989				83				
	1989–1990				104				
	1990–1991				132				
	1991–1992				161				

Table 2 Continued

Unit	Regulatory year	Reported harvest M	F	Unk	Total	Method of take Trap/ Snare	Shot	Unk/ Other	Wolf control
	1992–1993				151				
	1993–1994				321				
	1994–1995				148				
	1995–1996				123				
	1996–1997				209				
	1997–1998				113				
	1998–1999				173				

[a] One killed by other wolves.
[b] Includes wolf control removal.

Table 3 Units 20A, 20B, 20C, 20F, and 25C wolf harvest chronology, regulatory years 1985–1986 through 1998–1999

Unit	Regulatory year	Harvest periods			*n*
		Aug–Oct	Nov–Jan	Feb–Apr	
20A	1985–1986	2	11	11	24
	1986–1987	0	24	9	33
	1987–1988	3	22	11	36
	1988–1989	4	11	17	32
	1989–1990	8	13	10	31
	1990–1991	5	27	24	56
	1991–1992	7	36	24	67
	1992–1993	4	31	22	57
	1993–1994	15	91	37	143[a]
	1994–1995	5	52	7	64[a]
	1995–1996	4	38	15	57
	1996–1997	4	36	21	61
	1997–1998	6	20	15	41
	1998–1999	9	35	28	72
20B	1985–1986	1	9	15	25
	1986–1987	0	5	1	6
	1987–1988	0	9	9	18
	1988–1989	2	27	5	34
	1989–1990	4	18	13	35
	1990–1991	1	7	3	11
	1991–1992	7	25	24	56
	1992–1993	6	26	15	47
	1993–1994	2	60	39	101
	1994–1995	10	26	13	49
	1995–1996	4	29	11	44
	1996–1997	4	49	30	83
	1997–1998	7	23	19	49
	1998–1999	9	28	26	63
20C	1985–1986	0	3	3	6
	1986–1987	0	3	0	3
	1987–1988	2	8	2	12
	1988–1989	1	10	0	11
	1989–1990	0	8	9	17
	1990–1991	2	19	25	46
	1991–1992	0	12	9	21
	1992–1993	0	7	10	17
	1993–1994	1	12	16	29
	1994–1995	2	4	5	11
	1995–1996	1	1	5	7

Table 3 Continued

Unit	Regulatory year	Harvest periods Aug–Oct	Nov–Jan	Feb–Apr	*n*
	1996–1997	2	11	24	37
	1997–1998	0	8	1	9
	1998–1999	1	17	9	27
20F	1985–1986	0	1	1	2
	1986–1987	0	1	1	2
	1987–1988	0	2	3	5
	1988–1989	0	1	3	4
	1989–1990	2	5	7	14
	1990–1991	0	4	3	7
	1991–1992	0	6	5	11
	1992–1993	0	1	1	2
	1993–1994	1	6	3	10
	1994–1995	0	1	6	7
	1995–1996	1	0	0	1
	1996–1997	2	4	4	10
	1997–1998	3	3	5	11
	1998–1999	0	2	0	2
25C	1985–1986	0	1	1	2
	1986–1987	0	0	1	1
	1987–1988	0	9	1	10
	1988–1989	0	1	2	3
	1989–1990	2	0	5	7
	1990–1991	3	6	3	12
	1991–1992	0	1	6	7
	1992–1993	1	10	17	28
	1993–1994	2	7	10	19
	1994–1995	1	7	5	13
	1995–1996	0	5	5	10
	1996–1997	2	11	4	17
	1997–1998	0	0	2	2
	1998–1999	0	2	3	5
3-year total (1996–1998)		49 (10%)	249 (51%)	191 (39%)	

[a] Includes wolf control removal.

Table 4 Units 20A, 20B, 20C, 20F, and 25C wolf harvest by transport method, regulatory years 1985–1986 through 1998–1999

Unit	Regulatory year	Harvest by transport method									
		Airplane	Dogsled, skis, snowshoes	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Horse	Unk	*n*
20A	1985–1986	7	8	0	0	5	0	0	0	4	24
	1986–1987	5	0	0	2	28	0	0	0	0	35[a]
	1987–1988	9	1	0	1	24	0	1	0	0	36
	1988–1989	14	0	0	0	17	1	0	0	0	32
	1989–1990	4	0	0	1	17	0	3	1	5	31
	1990–1991	42	1	0	1	10	0	1	0	1	56
	1991–1992	25	2	0	2	34	1	2	0	1	67
	1992–1993	21	3	0	0	30	0	0	0	2	56
	1993–1994	16	0	0	1	37	0	0	0	6	62[d]
	1994–1995	5	2	0	0	21	0	2	0	0	30[c]
	1995–1996	5	4	0	0	46	0	2	0	2	59
	1996–1997	15	3	1	0	39	0	3	1	0	62
	1997–1998	0	3	0	1	27	1	7	1	1	41
	1998–1999	10	1	1	2	52	1	1	2	6	76
20B	1985–1986	5	1	0	0	14	0	2	0	3	25[b]
	1986–1987	2	0	0	0	4	0	0	0	0	6
	1987–1988	2	0	0	0	16	0	0	0	0	18
	1988–1989	5	0	1	1	26	0	1	0	0	34
	1989–1990	9	0	1	0	15	1	5	4	0	35
	1990–1991	2	2	0	1	6	0	0	0	0	11
	1991–1992	10	1	1	1	34	1	4	0	3	55
	1992–1993	6	1	1	0	34	1	3	0	1	47
	1993–1994	4	2	0	1	81	0	4	0	11	103
	1994–1995	8	0	1	1	32	0	7	0	1	50
	1995–1996	1	2	1	1	37	0	1	0	1	45
	1996–1997	11	7	1	0	54	1	8	0	1	83
	1997–1998	2	1	0	3	36	0	6	0	1	49
	1998–1999	1	3	0	2	46	0	10	0	1	63
20C	1985–1986	0	3	0	0	2	0	1	0	0	6
	1986–1987	0	2	0	0	1	0	0	0	0	3[c]
	1987–1988	3	0	0	3	5	0	1	0	1	13
	1988–1989	3	0	1	2	2	0	1	0	0	9[c]
	1989–1990	9	0	0	0	7	0	0	1	0	17

Table 4 Continued

Unit	Regulatory year	Harvest by transport method									
		Airplane	Dogsled, skis, snowshoes	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Horse	Unk	*n*
	1990–1991	22	10	0	0	5	0	3	0	6	46
	1991–1992	7	2	0	0	12	0	0	0	0	21
	1992–1993	1	4	0	0	10	0	0	0	0	15
	1993–1994	12	4	0	0	12	0	1	0	0	29
	1994–1995	3	3	1	0	3	0	1	0	0	11
	1995–1996	0	0	0	1	6	0	0	0	0	7
	1996–1997	1	2	1	0	29	0	0	0	4	37
	1997–1998	2	2	0	0	5	0	0	0	1	10
	1998–1999	0	7	1	0	17	0	0	0	2	27
20F	1985–1986	0	0	0	0	0	0	0	0	0	0
	1986–1987	0	2	0	0	0	0	0	0	0	2
	1987–1988	3	1	0	0	1	0	0	0	0	5
	1988–1989	0	0	0	0	4	0	1	0	0	5
	1989–1990	0	0	2	0	7	0	0	5	0	14
	1990–1991	0	2	0	0	5	0	0	0	0	7
	1991–1992	0	0	0	0	8	0	2	0	0	10
	1992–1993	0	0	0	0	1	0	1	0	0	2
	1993–1994	1	1	1	1	6	0	0	0	0	10
	1994–1995	5	1	0	0	1	0	0	0	0	7
	1995–1996	0	0	0	1	0	0	0	0	0	1
	1996–1997	0	2	1	0	5	0	2	0	0	10
	1997–1998	1	0	1	0	7	0	2	0	0	11
	1998–1999	0	0	0	0	2	0	0	0	0	2
25C	1985–1986	0	1	0	0	0	0	0	0	1	2
	1986–1987	0	0	0	0	0	0	1	0	0	1
	1987–1988	0	4	0	0	6	0	0	0	0	10
	1988–1989	2	1	0	0	0	0	0	0	0	3
	1989–1990	5	0	0	2	0	0	0	0	0	7
	1990–1991	5	1	0	1	1	1	2	0	1	12
	1991–1992	4	0	0	0	2	0	1	0	0	7
	1992–1993	13	0	0	0	15	0	0	0	0	28
	1993–1994	10	0	0	1	4	1	3	0	0	19
	1994–1995	0	0	1	0	11	0	1	0	0	13
	1995–1996	1	0	0	0	8	0	0	0	1	10

Table 4 Continued

Unit	Regulatory year	Harvest by transport method: Airplane	Dogsled, skis, snowshoes	Boat	3- or 4-wheeler	Snowmachine	ORV	Highway vehicle	Horse	Unk	*n*
	1996–1997	6	0	0	1	10	0	0	0	0	17
	1997–1998	0	0	0	0	2	0	0	0	0	2
	1998–1999	2	0	0	0	2	0	1	0	0	5

[a] Excludes 1 Denali National Park wolf.

[b] Excludes 28 wolves taken by Alaska Department of Fish and Game (ADF&G).

[c] Excludes 2 Denali National Park wolves.

[d] Excludes 98 wolves taken by ADF&G.

[e] Excludes 36 wolves taken by ADF&G.

Alaska's Game Management Units